

### 3.4 HANFORD SITE

Hanford, established in 1943 as one of the three original Manhattan Project sites, is located on approximately 148,000 hectares (365,000 acres) in Washington State, just north of Richland. It extends over parts of Adams, Benton, Grant, and Franklin counties. Hanford was a U.S. Government defense materials production site that included nuclear reactor operation, uranium and plutonium processing, storage and processing of spent nuclear fuel, and management of radioactive and hazardous and state dangerous wastes. Present Hanford programs are diversified and include management of radioactive wastes, cleanup of waste sites, soil, and groundwater related to past releases, stabilization and storage of spent nuclear fuel, renewable energy technologies, waste disposal technologies, contamination cleanup, and plutonium stabilization and storage (DOE 1999k). The primary emphasis at the site is on cleanup activities.

Hanford is owned and used primarily by DOE, but portions of it are owned, leased, or administered by other Government agencies. Public access is limited to travel on the Route 4 and Route 10 access roads as far as the Wye Barricade, State Routes 24 and 240, and the Columbia River. By restricting access to the site, the public is buffered from areas formerly used for production of nuclear materials and currently used for waste storage and disposal. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly vacant land with widely scattered facilities. On June 9, 2000, the President issued a proclamation that established the 78,900-hectare (195,000-acre) Hanford Reach National Monument (65 FR 37253). This proclamation recognizes the unique character and biological diversity of the area, as well as its geological, paleontological, historic, and archaeological significance. The monument includes not only land adjacent to the Columbia River, but also other areas on the Hanford Site as depicted on **Figure 3-12**. The U.S. Fish and Wildlife Service will manage the monument under existing agreements with DOE. Land within the monument that is not subject to existing agreements will be managed by DOE; however, DOE will consult with the Secretary of the Interior when developing any management plans affecting these lands.

Hanford includes extensive production, service, research, and development areas. Onsite programmatic and general purpose facilities, many of which are inactive, total approximately 799,000 square meters (8.6 million square feet) of space. Fifty-one percent (408,000 square meters [4.4 million square feet]) is general purpose space, including offices, laboratories, shops, warehouses, and other support facilities. The remaining 392,000 square meters (4.2 million square feet) of space are programmatic facilities including processing, evaporation, filtration, waste recovery, waste treatment, waste storage facilities, and research and development laboratories. More than half of the general purpose and programmatic facilities are more than 30 years old. Facilities designed to perform previous missions are being evaluated for reuse in the cleanup mission. The existing facilities are grouped into the following numbered operational areas (DOE 1996b:3-20, 3-21).

The 100 Areas, in the northern part of the site on the southern shore of the Columbia River, are the site of eight retired plutonium production reactors and the dual-purpose N Reactor, all of which have been permanently shut down since 1991. Waste sites throughout the 100 Areas are currently undergoing remediation, consisting of excavating contaminated soils and structural materials. Contaminated groundwater in the 100 Areas is being treated via both ex situ and in situ methods. Approximately 2,000 metric tons (2,200 tons) of spent nuclear fuel are currently stored in indoor basins in the 100 Areas pending approval and storage in the 200 Areas. The 100 Areas cover about 1,100 hectares (2,720 acres).

The 200-West and 200-East Areas are in the center of the site and are about 8 and 11 kilometers (5 and 6.8 miles), respectively, south of the Columbia River. The 200-West and 200-East Areas are also about 20 and 12 kilometers (12.2 and 7.3 miles), respectively, west of the Columbia River. Historically, these areas have been used for fuel processing; plutonium processing, fabrication, and storage; and waste management and disposal activities. DOE has constructed the Environmental Restoration Disposal Facility in the 200 Area to provide disposal capacity for environmental remediation waste (e.g., low-level, mixed low-level, and

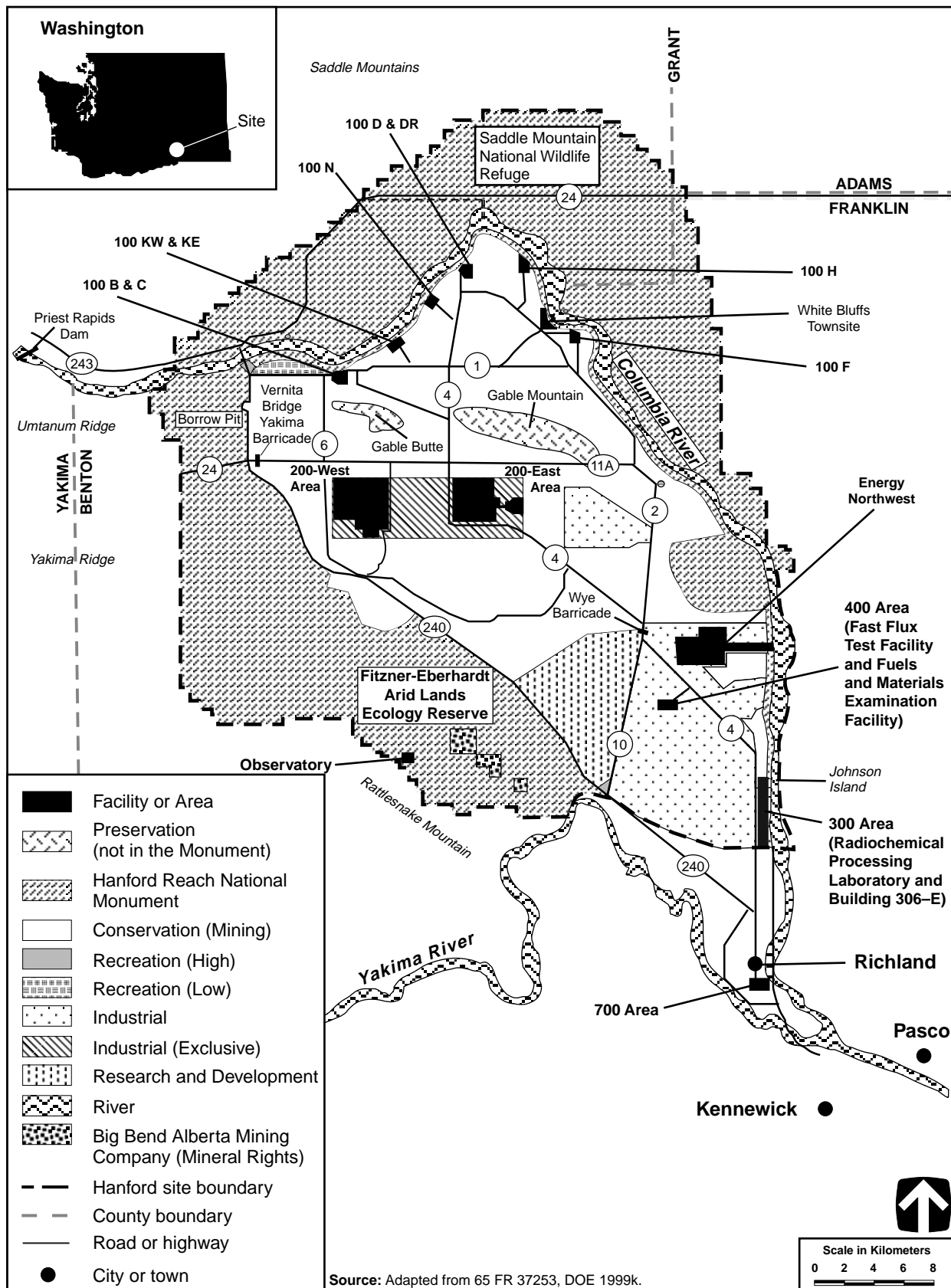


Figure 3-12 Generalized Land Use at the Hanford Site and Vicinity

dangerous wastes) generated during remediation of the 100, 200, and 300 Areas of the Hanford Site. The facility currently covers about 130 hectares (320 acres) and can be expanded up to 414 hectares (1,020 acres) as additional waste disposal capacity is required (DOE 1999k). The 200 Areas cover about 1,600 hectares (3,950 acres).

The 300 Area is in the southern part of the site, just north of the city of Richland. A few of the facilities continue to support nuclear and nonnuclear research and development of the Pacific Northwest National Laboratory. Many of the facilities in the 300 Area are in the process of being deactivated. The Environmental Molecular Sciences Laboratory and associated research programs provide research capability to advance technologies in support of DOE's environmental remediation and waste management programs (DOE 1999k). Waste sites in the 300 Area are currently undergoing remediation, consisting of excavating contaminated soils and structural materials. The 300 Area has also been proposed for accelerated remediation of waste sites and inactive buildings to support future non-DOE uses. The 300 Area covers 150 hectares (370 acres). The Radiochemical Processing Laboratory (RPL) (Building 325) and the Development Fabrication Test Laboratory (Building 306-E) are located in this area and would be used under certain alternatives under this NI PEIS.

The 400 Area, 8 kilometers (5 miles) northwest of the 300 Area, is the location of FFTF and FMEF. FFTF was designed and built as a liquid-metal (sodium) cooled reactor to be the nation's leading test reactor for development and testing of materials and equipment for the Liquid Metal Fast Breeder Reactor Programs. The reactor was neither designed nor operated as a breeder reactor itself. FFTF operated for about 10 years (1982–1992) as a national research facility testing advanced nuclear fuels, materials, components, active and passive reactor safety technologies, and gaining operating experience for the next generation of nuclear reactors. FFTF also produced a wide variety of medical isotopes and made tritium for the U.S. fusion research program. In 1995, FFTF was in the process of being shutdown, but was directed in 1997 to maintain a standby condition. The final decision on this reactor is to be determined in the Record of Decision for this NI PEIS.

FMEF, located in the 400 Area adjacent to the west of FFTF, was constructed in the late 1970s and early 1980s to perform fuel fabrication and development and postirradiation examination of breeder reactor fuels. FMEF was never operated and is currently in a lay-up condition suitable for a future mission. The building is clean and uncontaminated, as no nuclear materials were ever introduced into the building. The six-level process building (Building 427) is the main structure of FMEF and encloses about 17,400 square meters (188,000 square feet) of operating area. FMEF also consists of several connected buildings. The exterior walls are reinforced concrete and the cell walls are constructed of high-density concrete. The facility was designed and constructed for spent fuel examination and was equipped for mixed oxide fuel fabrication.

Other areas at Hanford include Energy Northwest facilities and a section of land currently owned by Washington State for the disposal of hazardous substances. Energy Northwest currently operates Washington Nuclear Plant Number 2 on leased land approximately 4 kilometers (2.5 miles) northeast of the 400 Area. Originally leased for the operation of three nuclear power plants, construction of two of the plants was stopped and now other industrial options are being considered. Other facilities at Hanford include a specialized training center, the Hazardous Materials Management and Emergency Response (HAMMER) Volpentest Training and Education Center, which is used to train hazardous materials response personnel. It is located in the southeastern portion of the site and covers about 32 hectares (80 acres). The Hanford Patrol Training Academy, a regional law-enforcement training facility, provides classrooms, library resources, practice shoot houses, an exercise gym, and an obstacle course. The Laser Interferometer Gravitational Wave Observatory, a national research facility, built by the National Science Foundation for scientific research, is designed to detect cosmic gravitational waves. The facility consists of two optical tube arms, each 4 kilometers (2.5 miles) long, arrayed in an "L" shape, and extremely sensitive to vibrations (DOE 1999k). The 700 Area is the administrative center in downtown Richland and consists of Government-owned buildings (e.g., the Federal Building).

In addition, there are DOE-leased facilities and DOE contractor-owned facilities that support Hanford operations. These facilities are on private land south of the 300 Area and outside of the 1100 and 3000 Areas (DOE 1996b:3-21).

DOE has transferred the 1100 Area (which served as a procurement, central warehousing, vehicle maintenance, transportation, and distribution center for the Hanford Site) and the smaller 3000 Area to the Port of Benton for use in economic development and diversification (DOE 1998g, 1998h, 1998i).

### **3.4.1 Land Resources**

Land resources include land use and visual resources. Each of these resource areas is described for the site as a whole, as well as for the locations of the proposed activities.

#### **3.4.1.1 Land Use**

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources such as ecological, cultural, geological, aquatic, and atmospheric.

##### **3.4.1.1.1 General Site Description**

The Tri-Cities area southeast of Hanford includes residential, commercial, and industrial land use. This area, encompassing the cities of Richland, Kennewick, and Pasco, is the population center closest to Hanford. Additional cities near the southern boundary of Hanford include Benton City, Prosser, and West Richland. Agriculture is a major land use in the remaining areas surrounding Hanford. In 1996, wheat was the largest crop in terms of area planted in Benton, Franklin, and Grant counties. Alfalfa, apples, asparagus, cherries, corn, grapes, and potatoes are some of the other major crops in Benton, Franklin, and Grant counties.

DOE has designated the entire Hanford Site as a National Environmental Research Park, an outdoor laboratory for ecological research to study the environmental effects of energy development. The Hanford National Environmental Research Park is a shrub-steppe habitat that contains a wide range of semiarid land ecosystems and offers the opportunity to examine linkages between terrestrial, subsurface, and aquatic environments.

Land use designations at Hanford include preservation, conservation, recreation, industrial, and research and development (Figure 3–12). Approximately 6 percent of the site has been disturbed and is occupied by DOE facilities (Neitzel 1999). Hanford contains a variety of widely dispersed facilities, including retired reactors, research and development facilities, and various deactivated production and processing plants. Preservation and conservation are the largest land use categories at Hanford. Industrial areas include the 200 Areas, an area to the east of the 200 Areas, and most of the southeast corner of the site.

Important areas within the preservation land use category include the Hanford Reach National Monument, that incorporates a portion of the Columbia River corridor, as well as the Fitzner-Eberhardt Arid Lands Ecology Reserve to the south and west, and portions of the Hanford Site north of the Columbia River (65 FR 37253). Other special status land in the vicinity include McNary National Wildlife Refuge, administered by the U.S. Fish and Wildlife Service, and the Columbia River Islands Area of Critical Environmental Concern and McCoy Canyon, both administered by the Bureau of Land Management. The Columbia River, which is adjacent to and runs through the Hanford Site, is used for numerous purposes including public boating, water skiing, fishing, hunting, transportation, irrigation, and municipal water supply. Public access is allowed on certain islands, while other areas are considered sensitive because of unique habitats and the presence of

cultural resources. The area known as the Hanford Reach includes the quarter-mile strip of public land on either side of the last free-flowing, nontidal segment of the Columbia River. On June 9, 2000, the President issued a proclamation that established the Hanford Reach National Monument (65 FR 37253) covering 78,900 hectares (195,000 acres). This proclamation recognizes the unique character and biological diversity of the area, as well as its geological, paleontological, historic, and archaeological significance. The U.S. Fish and Wildlife Service will manage the monument under existing agreements with DOE. Land within the monument that is not subject to existing agreements will be managed by DOE; however, DOE will consult with the Secretary of the Interior when developing any management plans affecting these lands.

On June 27, 2000, a fire known as the 24 Command Fire, was started by a fatal motor vehicle accident on State Route 24, about 2 miles west of the State Route 240 intersection. As a result of high winds and temperatures and low humidity, the fire spread rapidly and eventually consumed 66,322 hectares (163,884 acres) of Federal, state, and private lands. A total of 24,384 hectares (60,254 acres) within Hanford burned, including lands within the Hanford Reach National Monument, most of the Arid Lands Ecology Reserve, and areas near former production sites (Figures 3–12 and 3–21). The fire was declared controlled on July 2, 2000. Fire suppression impacts included construction of 66 kilometers (41 miles) of bulldozed fire lines, widened dirt roads, and cut fences (DOI 2000). Wind and sheet and rill erosion are likely due to the loss of vegetation and fire fighting activities. Impacts to the land should not be permanent because rehabilitation measures, including revegetation and fence repair, are being implemented.

The Hanford Site has developed a comprehensive land use plan to define how to best use the land at the site for the next 50 years (DOE 1999k). The plan provides the framework within which future use of the site's lands and resources will occur. This framework consists of four basic elements including: a land use map depicting land uses for the site; land use definitions describing the purpose, intent, and principal uses of each land use designation; a set of policies directing land use actions; and implementing procedures. Figure 3–12 reflects the land use categories developed in the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999k) as modified by the designation of the Hanford Reach National Monument.

Under separate treaties signed in 1855, lands occupied by the present Hanford Site were ceded to the United States by the Confederated Tribes and Bands of the Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe of Western Idaho. Under these treaties, the tribes retained the right to fish in their usual and accustomed places, hunt, gather roots and berries, and pasture horses and cattle on open, unclaimed lands. Tribal fishing rights have been recognized as effective within the Hanford Reach. Tribal governments and DOE, however, disagree over the applicability of tribal member's treaty-reserved rights to hunt, gather plants, and pasture livestock on the Hanford Site. The tribes and DOE have proceeded with the land use planning process, while reserving all rights to assert their respective positions regarding treaty rights (DOE 1999k).

#### **3.4.1.1.2 Locations of Proposed Activities**

##### **300 AREA**

The *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999k) and Record of Decision (64 FR 61615) have designated the 300 Area as an industrial area for the foreseeable future. An industrial area is defined in that EIS as an area that is suitable and desirable for activities such as reactor operations, transport facilities, mining, manufacturing, warehousing, and distribution operations. The 300 Area, which is just north of the city of Richland and west of the Columbia River, covers 150 hectares (371 acres). It is the site of former reactor fuel fabrication facilities and is also the principal location of nuclear research and development facilities serving the Hanford Site. The RPL/306–E buildings are in the 300 Area.

## 400 AREA

Under the *Hanford Comprehensive Land-Use Plan EIS* (DOE 1999k) and Record of Decision (64 FR 61615) land in the 400 Area is designated for industrial use, including reactor operations, for the foreseeable future. The 400 Area occupies 60 hectares (150 acres) and is 7 kilometers (4.3 miles) to the west of the nearest site boundary. It is the site of FFTF and FMEF. FFTF is a test reactor that was used for the development and testing of materials and equipment for the liquid metal breeder reactor program. FMEF is an unused building designed and constructed for spent fuel examination and equipped for mixed oxide fuel fabrication.

### 3.4.1.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape.

#### 3.4.1.2.1 General Site Description

Hanford is in the Pasco Basin of the Columbia Plateau north of the city of Richland, where the Yakima and Columbia Rivers join. The topography of land in the vicinity of Hanford ranges from generally flat to gently rolling. Rattlesnake Mountain, rising to 1,060 meters (3,480 feet) above mean sea level, forms the southwestern boundary of the site. Gable Mountain and Gable Butte are the highest land forms within the site, rising approximately 60 meters (200 feet) and 180 meters (590 feet), respectively. The Columbia River flows through the northern part of the site and, turning south, forms part of the eastern site boundary. White Bluffs, steep whitish-brown bluffs adjacent to the Columbia River and above the northern boundary of the river in this region, are a striking feature of the landscape.

Typical of the regional shrub-steppe desert, the site is dominated by widely spaced, low-brush grasslands. A large area of unvegetated, stabilized sand dunes extends along the east boundary, and unvegetated blowouts are scattered throughout the site. Hanford is characterized by mostly undeveloped land, with widely spaced clusters of industrial buildings along the southern and western banks of the Columbia River and at several interior locations.

Between June 27 and July 2, 2000, a fire known as the 24 Command Fire burned 66,322 hectares (163,884 acres) of Federal, state, and private lands, including 24,384 hectares (60,254 acres) within Hanford (DOI 2000). Areas burned included land within the Hanford Reach National Monument, most of the Arid Lands Ecology Reserve, and areas near former production sites (see Figure 3–12). Firefighting activities resulted in the construction of 66 kilometers (41 miles) of bulldozed fire lines, widened dirt roads, and cut fences. Thus, both the fire and the activities required to control it resulted in dramatic changes to the visual character of affected portions of the site. Visual resources would likely also be affected by dust storms resulting from exposed soil. These alterations to the visual character of Hanford will change over time as rains promote the growth of vegetation, fire lines are rehabilitated, and fences are repaired. Because of the slow regeneration of sagebrush, however, it will be years before the visual character of the landscape will mirror pre-fire conditions.

The adjacent visual landscape consists primarily of rural rangeland and farms. The city of Richland, part of the Tri-Cities area, is the only adjoining urban area. Viewpoints affected by DOE facilities are primarily associated with the public access roadways (including State Routes 24 and 240, Hanford Road, Horn Rapids Road, Route 4 South, and Steven Drive), the bluffs, and the northern edge of the city of Richland. The Energy Northwest (formerly known as the Washington Public Power Supply System) nuclear reactors and DOE

facilities are brightly lit at night and are highly visible from many areas. Developed areas are consistent with a Bureau of Land Management Visual Resource Management Class IV rating, while the remainder of the Hanford Site ranges in Visual Resource Management rating from Class II to Class III (DOI 1986). Management activities within Class II and III areas may be seen, but should not dominate the view, while management activities in Class IV areas dominate the view and are the focus of viewer attention.

#### **3.4.1.2.2 Locations of Proposed Activities**

##### **300 AREA**

The tallest structures within the 300 Area vicinity are the water towers, with a height of 40 meters (130 feet), and the meteorological tower with a height of 61 meters (200 feet) in height. The 300 Area is visible from Route 4, which runs in a north-south direction along the western boundary of the site (Nielsen 2000). Because the 300 Area is a highly developed industrial area, it has a Visual Resource Management Class IV rating. Natural features of visual interest within a 40-kilometer (25-mile) radius include the Columbia River immediately to the east, Rattlesnake Mountain at 24 kilometers (15 miles), Gable Mountain at 27 kilometers (17 miles), and Gable Butte at 35 kilometers (22 miles).

##### **400 AREA**

FMEF, the tallest building in the 400 Area, is 30 meters (100 feet) tall and can be seen from State Route 240. Developed areas within the 400 Area are consistent with a Visual Resource Management Class IV rating. Natural features of visual interest within a 40-kilometer (25-mile) radius include the Columbia River at 6.8 kilometers (4.2 miles), Rattlesnake Mountain at 17 kilometers (11 miles), Gable Mountain at 19 kilometers (12 miles), and Gable Butte at 27 kilometers (17 miles).

#### **3.4.2 Noise**

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

##### **3.4.2.1 General Site Description**

Major noise sources within the Hanford Site include various facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Wind has been identified as a major source of background sound levels at Hanford. Data from two noise surveys indicate that background noise levels (measured as the 24-hour equivalent sound level) at Hanford range from 30 to 60.5 dBA. The 24-hour background sound level in undeveloped areas at Hanford ranges from 24 to 36 dBA, except when high winds elevate sound levels. The primary source of noise at the site and nearby residences is traffic. Most Hanford industrial facilities are far enough from the site boundary that noise levels at the boundary from these sources are not measurable, or are barely distinguishable from background noise levels. Hanford is currently in compliance with state noise regulations. Noise sources, existing noise levels at Hanford, and noise standards are described in the *Storage and Disposition PEIS* (DOE 1996b:3-29–3-31, F-31, F-32) and in the 1999 *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Neitzel 1999:4.137-138).

The potential impact of traffic noise resulting from activities at Hanford was evaluated for a draft EIS addressing the siting of the proposed New Production Reactor (Neitzel 1999:4.138). Estimates were made of baseline traffic noise along two major access routes: State Route 24, leading from the Hanford Site west to Yakima, and State Route 240, south of the site and west of Richland, where it handles maximum traffic

volume. About 9 percent of the employees at Hanford commute by vanpool or bus. Modeled traffic noise levels (equivalent sound level [1-hour]) at 15 meters (50 feet) from State Route 24 for both peak and offpeak periods were 62 dBA. Traffic noise levels from State Route 240 for both peak and offpeak periods were 70 dBA. These traffic noise levels were projections based on employment levels about 30 percent higher than actual levels at Hanford in 1997. Existing traffic noise levels may be different as a result of changes in site employment and ride-sharing activities (DOE 1999e:3-8; Neitzel 1999:4.138-4.141).

Washington State has established noise standards for different source and receiving areas. Hanford belongs to source area Class C (industrial). The maximum allowable noise level for residential, commercial, and industrial areas is 50 to 70 dBA (DOE 1996b:3-29 and 3-31, Neitzel 1999:4.138). The EPA guidelines for environmental noise protection recommend a day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses (14 CFR Part 150). These guidelines further indicate that noise levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures. It is expected that for most residences near Hanford, the day-night average sound level is less than 65 dBA and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

### **3.4.2.2 Locations of Proposed Activities**

#### **300 AREA**

No distinguishing noise characteristics in the 300 Area have been identified. The 300 Area is just north of Richland and adjacent to the site boundary along the Columbia River. No sound level data have been collected in this area except for measurements that reflect traffic noise levels.

#### **400 AREA**

No distinguishing noise characteristics in the 400 Area have been identified. The 400 Area is far enough away from the site boundary, 7 kilometers (4.3 miles), that noise levels at the site boundary from these sources are not measurable or are barely distinguishable from background levels.

### **3.4.3 Air Quality**

Air pollution refers to the introduction, directly or indirectly of any substance into the air that could endanger human health, harm living resources and ecosystems as well as material property, and impair or interfere with the comfortable enjoyment of life or other legitimate uses of the environment. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

#### **3.4.3.1 General Site Description**

The climate at Hanford and the surrounding region is characterized as that of a semiarid steppe. The humidity is low and winters are mild. The average annual temperature is 11.8 °C (53.3 °F); average monthly temperatures range from a minimum of -0.4 °C (31.3 °F) in January to a maximum of 24.6 °C (76.2 °F) in July. The average annual precipitation is 16 centimeters (6.3 inches). Prevailing winds at the Hanford Meteorological Station are from the west-northwest. The average annual wind speed is 3.4 meters per second (7.6 miles per hour) (Dirkes, Hanf, and Poston 1999:7.5; DOE 1999e:3-5).

Most of Hanford is within the South-Central Washington Intrastate Air Quality Control Region #230, but a small portion of the site is in the Eastern Washington-Northern Idaho Interstate Air Quality Control Region #62. None of the areas within Hanford and its surrounding counties are designated as nonattainment areas, with respect to NAAQS for criteria air pollutants (40 CFR Section 81.348). However, particulate matter concentrations can reach relatively high levels in eastern Washington State because of extreme natural events, such as dust storms, volcanic eruptions, and large brush fires. Washington State ambient air quality standards have not considered “rural fugitive dust” from exceptional natural events when estimating the maximum background concentrations of particulates in the area east of the Cascade Mountain crest. In June 1996, EPA adopted the policy that allows dust storms to be treated as uncontrollable natural events. The air quality impact of dust storms can therefore be excluded during the determination of whether this area is in nonattainment for atmospheric particulates (Neitzel 1999). Applicable NAAQS and Washington State ambient air quality standards are presented in **Table 3–29**.

The primary sources of air pollutants at Hanford include emissions from power generation and chemical processing (Neitzel 1999:4.30). Other sources include vehicles, construction, environmental remediation, and waste management activities (Wisness 2000). The existing ambient air pollutant concentrations at the site boundary attributable to sources at Hanford are presented in Table 3–29. These concentrations are based on dispersion modeling using emissions for Hanford, excluding the 400 Area for 1999 (Wisness 2000). The 400 Area emissions during FFTF standby are estimated using the EPA Standard AP-42 guideline. The concentrations at the site boundary for the 400 Area were calculated using EPA’s SCREEN3 dispersion model; however, the concentrations from the other sources at the site were calculated using the ISCST3 dispersion model. SCREEN3 estimates of maximum concentrations are conservative when compared to the ISCST3 estimates. The ISCST3 modeling was performed using the 1999 meteorological data for Hanford, whereas the SCREEN3 modeling was performed using a set of worst-case meteorological conditions. Although the location for maximum concentrations may be different, for the purpose of this NI PEIS, it was assumed to be occurring at the same location.

Only those pollutants that would be emitted by any of the alternatives evaluated in this NI PEIS are presented. Hanford sources are limited and background concentrations of criteria pollutants are well below ambient standards. As shown in Table 3–29, these modeled concentrations from Hanford sources represent a small percentage of the ambient air quality standards. Hanford emissions should not result in air pollutant concentrations that violate the ambient air quality standards for criteria pollutants. Detailed information on emissions of other pollutants at Hanford is discussed in the *Hanford Site NEPA Characterization* (Neitzel 1999:4.27–4.32).

There are no Prevention of Significant Deterioration Class I areas within 100 kilometers (62 miles) of Hanford. A Class I area is one in which very little increase in pollution is allowed due to the pristine nature of the area. Hanford and its vicinity are classified as a Class II area in which more moderate increases in pollution are allowed. Hanford operates under a Prevention of Significant Deterioration permit issued in 1980. New emission sources require a Prevention of Significant Deterioration increment consumption analysis. The recent designation of the Hanford Reach as a national monument (65 FR 37253) might lead to a proposal to redesignate this area, that includes part of Hanford and adjoining areas, as Prevention of Significant Deterioration Class I, although that appears unlikely at this time due to a variety of political and technical issues.

**Table 3–29 Comparison of Modeled Ambient Air Concentrations from Hanford Sources with Most Stringent Applicable Standards or Guidelines**

Pollutant	Averaging Period	Most Stringent Standard or Guideline (micrograms per cubic meter) <sup>a</sup>	Maximum Hanford Concentration Excluding 400 Area (micrograms per cubic meter) <sup>b</sup>	Maximum 400 Area Concentration (micrograms per cubic meter)
<b>Criteria pollutants</b>				
Carbon monoxide	8 hours	10,000 <sup>c</sup>	23.8	3.5
	1 hour	40,000 <sup>c</sup>	58.2	5.1
Nitrogen dioxide	Annual	100 <sup>c</sup>	0.634	0.032
Ozone	1 hour	235 <sup>d</sup>	(e)	(e)
PM <sub>10</sub>	Annual	50 <sup>c</sup>	0.0162	0.002
	24 hours	150 <sup>c</sup>	0.112	0.898
Sulfur dioxide	Annual	50 <sup>f</sup>	0.0114	0.164
	24 hours	260 <sup>f</sup>	0.365	29.8
	3 hours	1,300 <sup>c</sup>	2.41	67.0
	1 hour	1,000 <sup>f</sup>	5.02	74.4
	1 hour	660 <sup>f, g</sup>	5.02	74.4
<b>Other regulated pollutants</b>				
Total suspended particulates	Annual	60	0.0162	0.002
	24 hours	150	0.112	0.898

- a. The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM<sub>10</sub> standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.
- b. Site contributions based on a 1999 emissions inventory, excluding the 400 Area.
- c. Federal and state standard.
- d. Federal 8-hour standard is currently under litigation.
- e. Not directly emitted or monitored by the site.
- f. State standard.
- g. Not to be exceeded more than twice in any 7 consecutive days.

**Note:** NAAQS also includes standards for lead. No sources of lead emissions have been identified at the site. Emissions of other air pollutants not listed here have been identified at Hanford, but are not associated with any alternative evaluated. EPA revised the ambient air quality standards for particulate matter and ozone in 1997; however, these standards were under litigation. In 1999, new standards, effective on September 16, 1997, could not be enforced. The ozone standard is a 1-hour concentration of 235 micrograms per cubic meter (0.12 parts per million) (62 FR 38856). The 8-hour standard could not be enforced. For particulate matter, the current PM<sub>10</sub> annual standard is retained (62 FR 38652).

**Source:** 40 CFR Part 50; WDEC 1998; Wisness 2000.

A sitewide air operating permit is being developed for Hanford, scheduled to be issued as a draft by the end of 2000, in accordance with Title V of the Clean Air Act and Amendments of 1990 and the Federal and state programs under 40 CFR Part 70 and WAC 173-401, respectively (WDEC 1997). The Hanford air operating permit will include a compilation of requirements for both radioactive emissions now covered by the existing state license and nonradioactive emissions. The primary effects of the air operating permit will be to consolidate approval orders and applicable requirements into one permit, require the permitted party to conduct periodic monitoring to show continuous compliance with permit conditions and applicable requirements, require biannual reporting and annual certification of continuous compliance, and increase the state's and EPA's enforcement position.

Based on 1996 monitoring conducted off site by the Washington State Department of Ecology, the annual and 24-hour  $PM_{10}$  standards were not exceeded (Neitzel 1999:4.29). Ambient air quality at Hanford is discussed in more detail in the *Hanford Site Environmental Report for Calendar Year 1998* (Dirkes, Hanf, and Poston 1999).

Routine monitoring of most nonradiological pollutants is not conducted at the site. Monitoring of nitrogen oxides and total suspended particulates at Hanford has been discontinued as a result of phasing out programs for which the monitoring was required. Carbon monoxide, sulfur dioxide, and nitrogen dioxide have been monitored periodically in communities and commercial areas southeast of Hanford. In 1995, air samples of semivolatile organic compounds were collected on the site and at an offsite location, and the results are discussed in the site's annual environmental report. All concentrations of these compounds were below the applicable risk-based concentrations.

### **3.4.3.2 Locations of Proposed Activities**

#### **300 AREA**

Prevailing winds in the 300 Area are from the southwest. The 300 Area emits various nonradiological air pollutants from power generation and process sources (Neitzel 1999:4.30, 4.31).

#### **400 AREA**

Prevailing winds in the 400 Area are from the south-southwest, with a secondary maximum from the northwest. The 400 Area emits various nonradiological air pollutants (see Sections 3.4.3.1 and 4.4.1.2.3) (Neitzel 1999:4.30).

### **3.4.4 Water Resources**

Water resources include all forms of surface water and subsurface groundwater.

#### **3.4.4.1 Surface Water**

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

##### **3.4.4.1.1 General Site Description**

Major surface water features at Hanford include the Columbia River, Columbia riverbank seepage, springs, and ponds (**Figure 3–13**). In addition, the Yakima River flows along a short section of the southern boundary of the site. The Columbia River is the second largest river in the contiguous United States in terms of total flow and is the dominant surface water feature on the site. Flow of the Columbia River is regulated by several dams, seven upstream and four downstream from the site. The nearest dam upstream from Hanford is the Priest Rapids Dam, and the closest downstream dam is the McNary Dam. The Hanford Reach is the portion of the Columbia River that extends from Priest Rapids Dam to the upstream edge of Lake Wallula behind McNary Dam. Because the flows are regulated, flow rates in the Hanford Reach can vary considerably; it is the last remaining free-flowing, nontidal section of the river. The average daily flow rate at Priest Rapids Dam is 3,360 cubic meters (118,700 cubic feet) per second. Peak flows generally occur from April through June corresponding to runoff from snowmelt. Due to larger than normal snowpacks, the peak flow rate in 1997 was nearly 11,750 cubic meters (415,000 cubic feet) per second. The width of the river varies from approximately 300 to 1,000 meters (1,000 to 3,300 feet) within the Hanford Site (Neitzel 1999:4.55, 4.56).

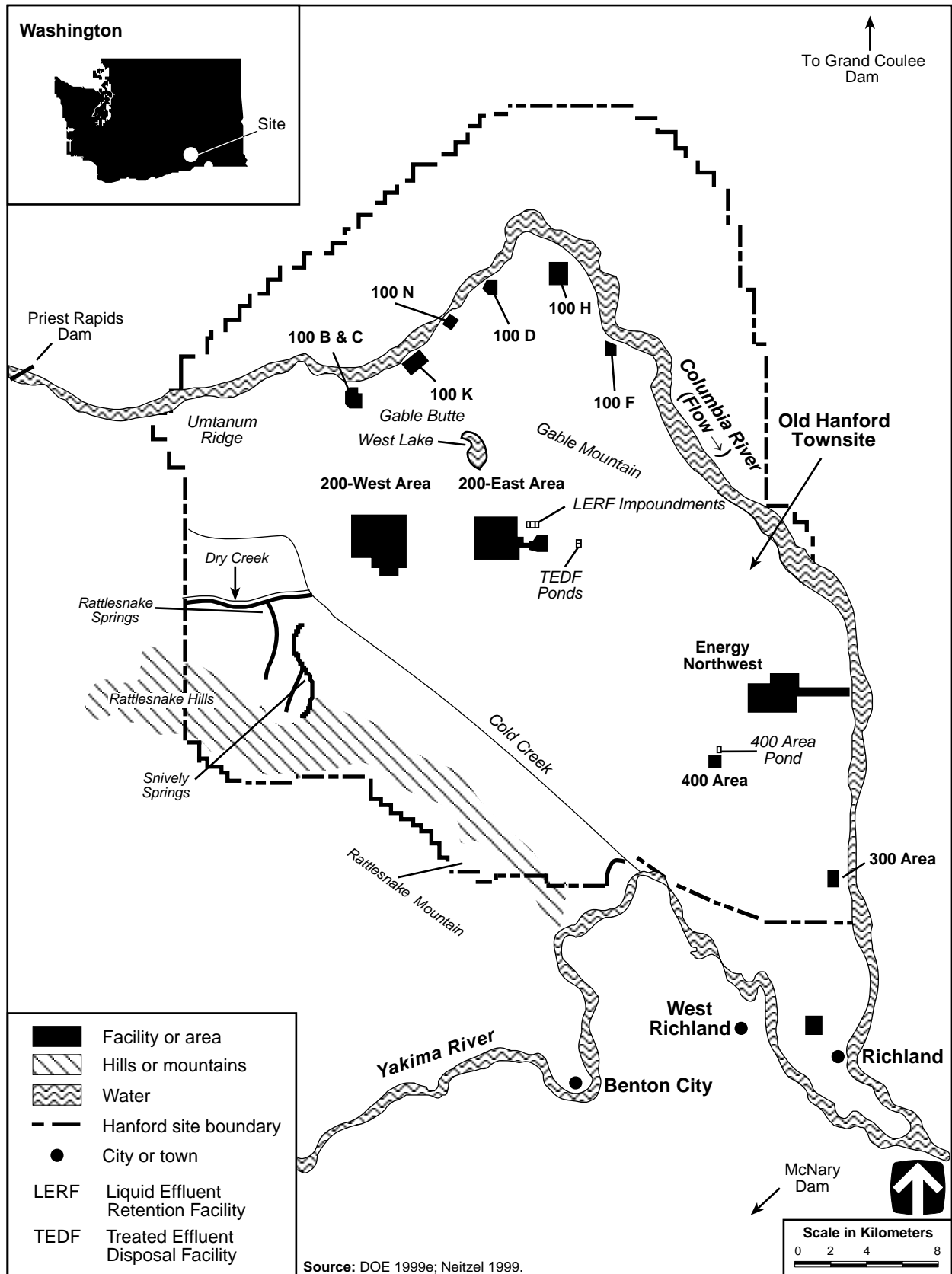


Figure 3-13 Surface Water Features at the Hanford Site

Primary uses of the Columbia River include hydroelectric power generation, irrigation of crops in the Columbia Basin, and barge transportation. The Hanford Reach is the upstream navigable limit of barge traffic. The Columbia River is also used extensively for recreation, including fishing, hunting, boating, sailboarding, water-skiing, diving, and swimming. In addition to a water supply source for the Hanford Site, several communities use the Columbia River as their source of drinking water (Neitzel 1999:4.56). Nine of the 12 DOE-owned, contractor-operated water plants on the Hanford Site use water from the Columbia River (Dirkes, Hanf, and Poston 1999:4.47–4.49).

The Washington State Department of Ecology classifies the Columbia River, from Grand Coulee to the Washington-Oregon border and encompassing the Hanford Reach, as Class A (excellent). Class A waters are suitable for essentially all uses, including raw drinking water, recreation, and wildlife habitat. Federal and state drinking water standards, and DOE Order 5400.5, apply to the Columbia River and are currently being met (DOE 1999k:4-35). Although no federally designated Wild and Scenic Rivers exist in the Hanford Site vicinity, the Hanford Reach is being considered for listing under the National Wild and Scenic Rivers Act as part of broader resource conservation initiatives (DOE 1999k:4-5; Neitzel 1999:6.10). The Hanford Reach was recently proclaimed a National Monument (refer to Section 3.4.1.1.1).

DOE continues to assert a federally reserved water withdrawal right for the Columbia River. Hanford withdraws approximately 13.5 billion liters (3.6 billion gallons) per year from the Columbia River (DOE 1999e:3-30).

About one-third of the Hanford Site drains into the Yakima River. The average daily flow rate for the Yakima River is 104 cubic meters (3,670 cubic feet) per second. The peak average daily flow rate in 1997 was nearly 1,300 cubic meters (45,900 cubic feet) per second (Neitzel 1999:4.58).

Rattlesnake Springs and Snively Springs are in the western portion of the site and flow into intermittent streams that infiltrate rapidly into the surface sediments (Figure 3–13). Water discharged from Rattlesnake Springs flows down Dry Creek, a tributary to Cold Creek, for about 3 kilometers (1.9 miles) before infiltrating into the ground. An alkaline spring has also been documented at the east end of Umtanum Ridge. Several springs are also found on the slopes of Rattlesnake Mountain along the western and southwestern edges of the site (DOE 1999k:4-30; Neitzel 1999:4.58). The seepage of groundwater into the Columbia River was documented along the Hanford Reach long before Hanford Site operations began. This seepage occurs both below the river surface and on the exposed riverbank. These relatively small seeps flow intermittently, influenced primarily by changes in river level. Hanford-origin contaminants have been documented in these discharges along the Hanford Reach (DOE 1999k:4-30; Neitzel 1999:4.65).

Other naturally occurring surface water features include West Lake and three previously undocumented clusters of approximately 20 vernal ponds or pools. The clusters are located on the eastern end of Umtanum Ridge, in the central part of Gable Butte, and at the eastern end of Gable Mountain. The ponds appear to form during the relatively wetter winter ponds in shallow depressions underlain by a layer of basalt (DOE 1999k:4-31; Neitzel 1999:4.67).

Artificial ponds also exist on the site primarily associated with waste management activities. These include: water storage ponds in the 100 K-Area, the two Treated Effluent Disposal Facility (TEDF) disposal ponds and the three Liquid Effluent Retention Facility impoundments adjacent to the 200-East Area, and the 400 Area Pond (FFTF Pond or 4608 B/C ponds) used by FFTF and other facilities (Figure 3–13) (DOE 1999k:4-31; Neitzel 1999:4.57, 4.67). While West Lake, a natural pond located north of the 200 Areas that predates Hanford operations, has not received effluents, it was sustained by the artificially elevated water table beneath much of Hanford, attributable to historic waste management activities and current wastewater disposal in the 200 Areas. Although not accessible to the public, these ponds are accessible by waterfowl (DOE 1999k:4-32;

Neitzel 1999:4.67, 4.88). In addition to these features, there are irrigation ponds and wetlands located in the northwest portion of the site and north of the Columbia River (Neitzel 1999:4.57, 4.67).

In 1998, the Hanford Site had two NPDES permits: Permit #WA-000374-3 and Permit #WA-002591-7. Permit #WA-000374-3 included four inactive outfalls in the 100-N Area and three active outfalls (two in the 100-K Area and one in the 300 Area). There were two instances of noncompliance for these outfalls in 1998. Permit #WA-002591-7 covered one outfall located at the 300 Area TEDF. The 300 Area TEDF had 14 exceedances in 1998. This disposal facility was in normal operation and meeting design specifications at the time of these events. All indications suggest that the facility is unable to consistently meet the restrictions of the facility's NPDES permit, despite the use of the best available technology. An application for a permit modification was submitted to EPA in November 1997 (Dirkes, Hanf, and Poston 1999:2.24, 2.25). The modification requested transfer of the two active 100-K Area outfalls from Permit #WA-000374-3 to Permit #WA-002591-7, among other items. A revised permit was issued April 2, 1999, and became effective May 5, 1999 (Chapin 1999). Revised effluent limits for the 300 Area TEDF were established under the modified Permit #WA-002591-7 (Dirkes, Hanf, and Poston 1999:2.25). Permit #WA-000374-3 has lapsed.

Hanford was covered by two industrial stormwater permits (WAR-00-000F, WAR-10-000F) in 1998. An annual comprehensive site compliance evaluation was performed and documented in 1998. In accordance with the September 30, 1998, Federal Register (63 FR 52430), the stormwater general permit for industrial activity (WAR-00-000F) was terminated and replaced by the multisector general stormwater permit (WAR-10-000F). On December 28, 1998, a Notice of Intent was submitted to EPA for coverage under the NPDES multisector permit (WAR-10-000F) (Dirkes, Hanf, and Poston 1999:2.25).

DOE Richland Operations Office has a pretreatment permit (CR-IU005) from the city of Richland for the discharge of wastewater from the Environmental Molecular Sciences Laboratory in the 300 Area. Also, there are numerous sanitary waste discharges to the ground through sanitary systems permitted by the Washington State Department of Health, as well as 400 Area sanitary waste discharges to the Energy Northwest treatment facility. Sanitary waste from the 300 Area and other facilities north of and in Richland discharge to the city of Richland treatment facility (Dirkes, Hanf, and Poston 1999:2.25).

Hanford is subject to a Washington State Department of Ecology liquid effluent consent order that regulates liquid effluent discharges to the ground. All state waste discharge permit applications for discharges covered under the consent order have been submitted. One new state waste discharge permit was issued on May 1, 1998, by the Washington State Department of Ecology (Permit ST-4509 for Hanford cooling water and condensate discharges). In 1998, there were eight noncompliances in three of the seven state waste discharge permits currently in place at Hanford. One of these was for exceeding the permit limit for manganese in the cooling water discharge to the 400 Area Pond. The exceedance was attributed to the naturally high levels of the metal in the source water (Dirkes, Hanf, and Poston 1999:2.25, 2.26).

All radiological contaminant concentrations measured in the Columbia River in 1998 were lower than the DOE Derived Concentration Guides and Washington State ambient surface water quality criteria. For nonradiological parameters, applicable standards for Class A—designated surface water were met, with results comparable to those over the past 5 years. During 1998, there was no evidence of deterioration in water quality attributable to Hanford operations along the Hanford Reach (Dirkes, Hanf, and Poston 1999:4.22, 4.27–4.29).

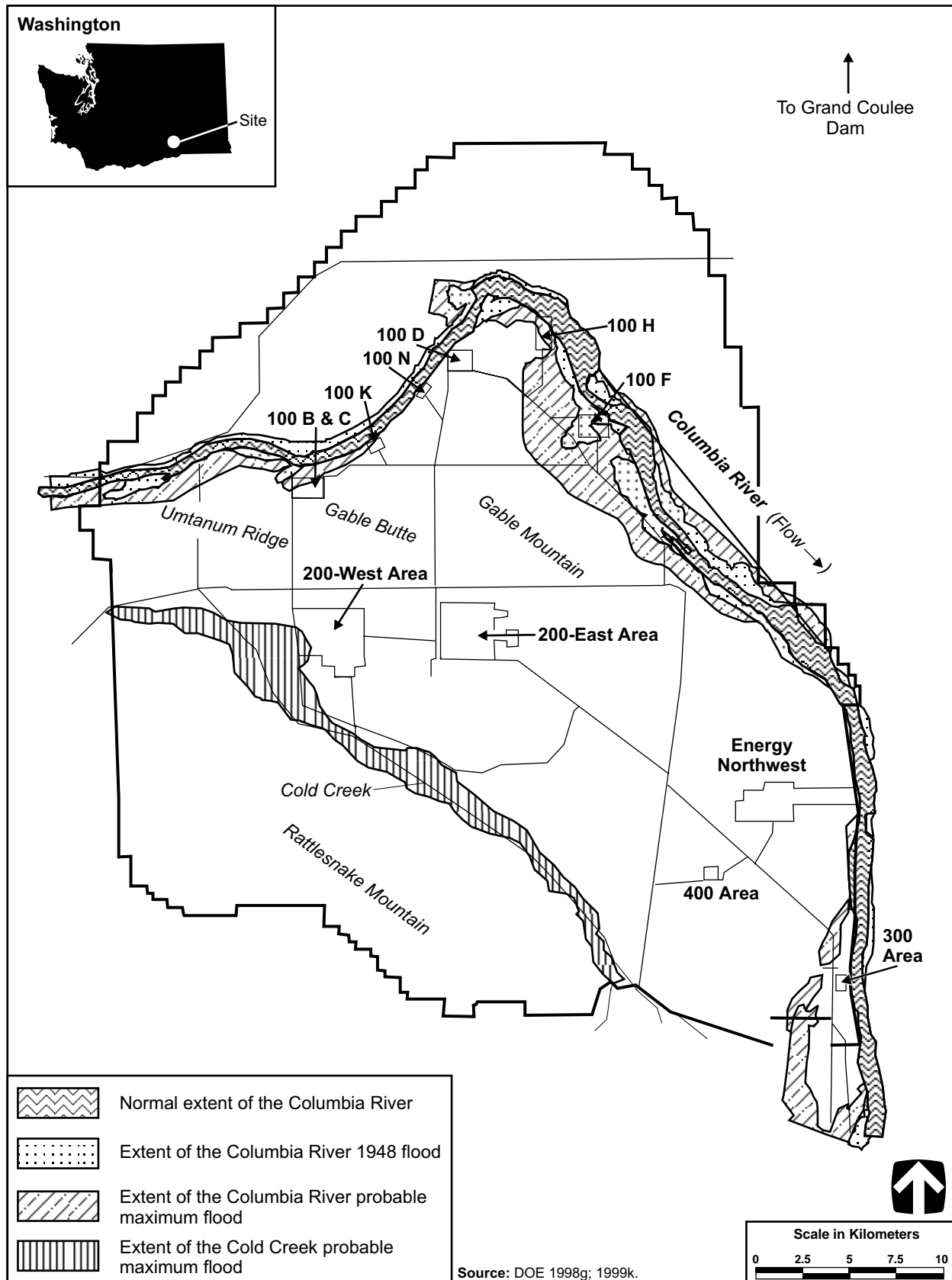
The Columbia River is also the primary discharge area for the unconfined aquifer underlying Hanford. The site conducts sampling of these groundwater seeps during low flow and refers to them as riverbank springs. Water samples were collected from eight Columbia River shoreline spring areas in 1998. All samples were analyzed for gamma-emitting radionuclides, gross alpha, gross beta, and tritium. Samples from selected

springs were analyzed for strontium-90; technetium-99; iodine-129; and uranium-234, 235, and 238. Samples were also analyzed for metals and anions (Dirkes, Hanf, and Poston 1999:4.20, 4.34–4.36).

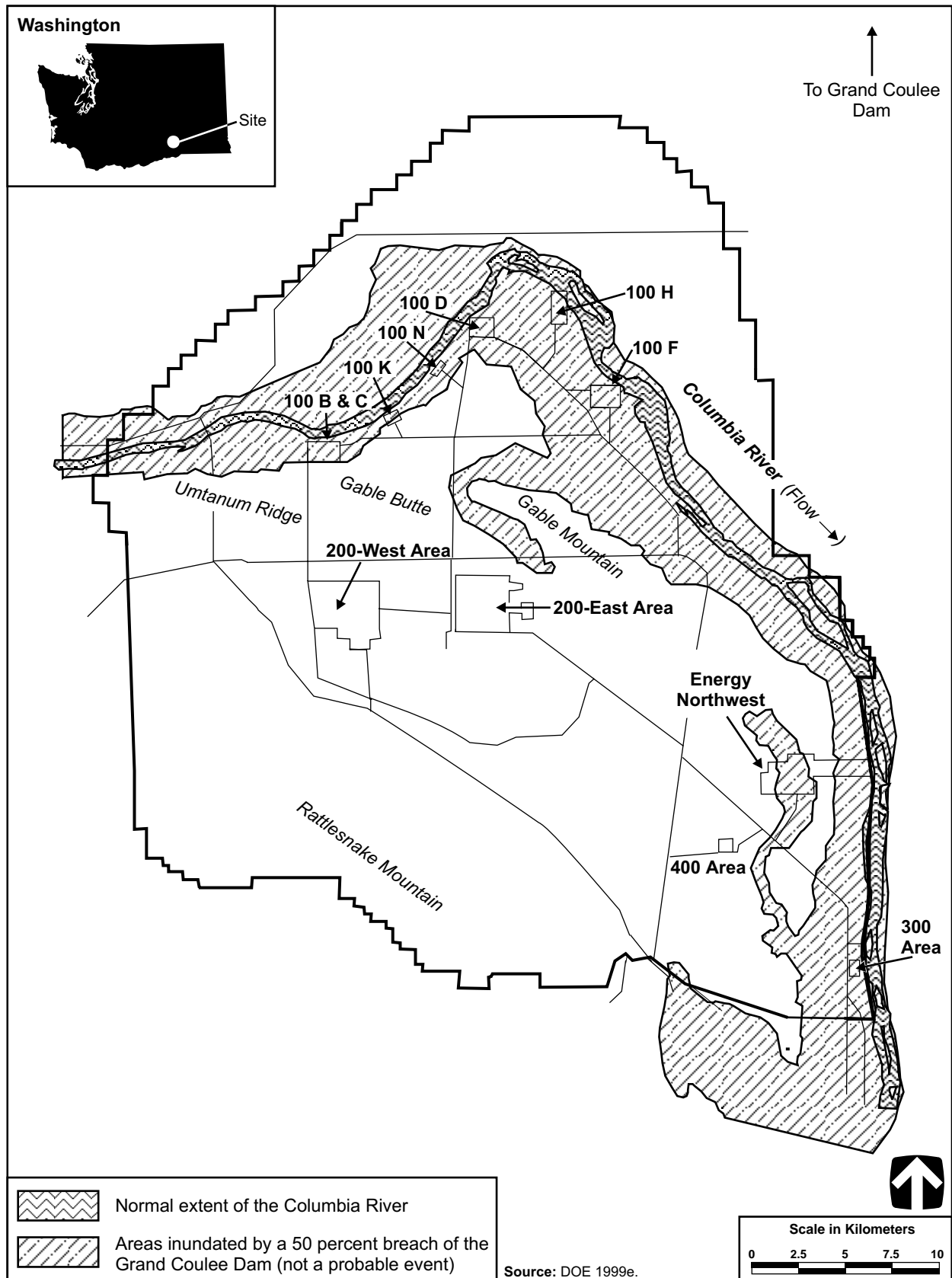
All radiological contaminant concentrations measured in 1998 were less than the DOE Derived Concentration Guides. Tritium in riverbank springs water at the Old Hanford Townsite (refer to Figure 3–13 for locations) and the 100-N Area exceeded the state ambient surface water quality criterion (20,000 picocuries per liter), with the maximum of 120,000 picocuries per liter observed at the Old Hanford Townsite. Gross beta activities in riverbank springs water at the 100-H Area exceeded the ambient criterion (50 picocuries per liter), with a maximum observed value of 72 picocuries per liter. While there are no ambient surface water quality criteria directly applicable to uranium, total uranium levels exceeded the site-specific proposed EPA drinking water standard in the 300 Area (equivalent to 13.4 picocuries per liter), with a maximum total uranium activity of 58 picocuries per liter. Gross alpha activity exceeded the ambient surface water quality criterion of 15 picocuries per liter in riverbank springs water at the 300 Area, with a maximum observed value of 56 picocuries per liter. This is consistent with the elevated uranium levels. All other radionuclide activities in 300 Area springs water were less than ambient surface water quality criteria (Dirkes, Hanf, and Poston 1999:4.36, A.10, A.11, C.3). Elevated uranium activities exist in the unconfined aquifer beneath the 300 Area in the vicinity of uranium fuel fabrication facilities and inactive waste sites. Elevated tritium activities have also been measured in the 300 Area riverbank springs and are indicators of the contaminated groundwater plume emanating from the 200 Areas. However, in 1998, the maximum observed activity level was 9,600 picocuries per liter and below the ambient surface water quality criterion (Dirkes, Hanf, and Poston 1999:4.38, C.4).

Nonradiological contaminants measured in riverbank springs located on the Hanford shoreline in 1998 were below the applicable Washington State ambient surface water criteria except for chromium concentrations in 100-B, 100-K, 100-D, and 100-H Area springs exceeding the acute toxicity level of 16 micrograms per liter (Dirkes, Hanf, and Poston 1999:4.38, C.4).

Flooding of the site has occurred along the Columbia River, but chances of recurrence have been greatly reduced by the construction of dams to regulate river flow. Major floods are typically due to the melting of the winter snowpack combined with above normal precipitation (Neitzel 1999:4.60). No maps of flood-prone areas have been produced by the Federal Emergency Management Agency. The Federal Emergency Management Agency produces these maps for areas capable of being developed, and the Hanford Site is not designated for commercial or residential development (DOE 1999k:4-34). However, analyses have been completed to determine the potential for the probable maximum flood. This is determined through hydrologic factors, including the amount of precipitation within the drainage basin, snow melt, and tributary conditions. The probable maximum flood for the Columbia River below the Priest Rapids Dam has been calculated at 40,000 cubic meters (1.4 million cubic feet) per second, which is greater than the 500-year flood (DOE 1999k:4-34; Neitzel 1999:4.60). The extent of the 1948 flood, and the extent of the probable maximum flood, are shown in **Figure 3–14**. Potential flooding due to dam failure has been evaluated by the U.S. Army Corps of Engineers. Upstream failures could have any number of causes, the magnitude of the resultant flooding depending on the size of the breach in the dam. The U.S. Army Corps of Engineers evaluated various scenarios for failure of the Grand Coulee Dam, located approximately 130 kilometers (80 miles) from Hanford, and assumed flow conditions of about 11,300 cubic meters (400,000 cubic feet) per second. The worst-case scenario assumed a 50 percent breach in the dam (**Figure 3–15**). The flood wave from an instantaneous 50 percent breach was calculated to be 600,000 cubic meters (21 million cubic feet) per second. In addition to the areas affected by the probable maximum flood, the remainder of the 100 Area, the 300 Area, and nearly all of Richland, Washington, would be flooded. Determinations were not made for larger instantaneous breaches in the Grand Coulee Dam, because the 50 percent scenario was believed to be the largest conceivable flow from a natural or manmade breach. It was not considered credible that a structure as large as the Grand



**Figure 3–14 Flood Area for the Probable Maximum Flood and Columbia River 1948 Flood**



**Figure 3-15 Flood Area of a 50 Percent Breach of the Grand Coulee Dam**

Coulee Dam could be 100 percent destroyed instantaneously. The analysis also assumed that the 50 percent breach would occur only as the result of direct explosive detonation, and not because of some natural event such as an earthquake (DOE 1999k:4.34; Neitzel 1999:4.60, 4.65).

### 3.4.4.1.2 Locations of Proposed Activities

#### 300 AREA

The 300 Area is located in the southeast corner of the site adjacent to the Columbia River. Although no site-specific flood analysis is available for the 300 Area, analyses have been completed for the site as a whole, as previously discussed. The 300 Area does not lie within the area postulated to be affected by the probable maximum flood, but locations just to the west of the area would be affected (Figure 3–14). However, the 300 Area would be inundated from a 50 percent breach of the Grand Coulee Dam (Figure 3–15). Water for the 300 Area, including for RPL/306–E, is provided by the city of Richland, which obtains about two-thirds of its water from the Columbia River (FDH 1999:3; Neitzel 1999:4.133). Water consumption in the 300 Area is approximately 594 million liters (157 million gallons) per year (FDH 1999:3). Sanitary wastewater from the 300 Area is discharged to the city of Richland treatment facility (Dirkes, Hanf, and Poston 1999:2.25).

RPL is connected to the 300 Area sanitary sewer system and to a separate retention process sewer system. This system collects equipment cooling water, laboratory waste liquids, and other liquids that have a slight potential for radioactive contamination. The retention process sewer system routes process wastewater to the 307 basins at the 340 Complex and ultimately to the 300 Area TEDF, which operates under NPDES Permit WA002591-7. The system is monitored for radioactivity and, if an alarm is triggered, the effluent is diverted to a dedicated basin at the 340 Complex. Otherwise, the effluent is screened at the 307 basins before being conveyed to the 300 Area TEDF. Direct sampling and analysis of the system is also conducted as needed (DOE 1997c: 4-58; 2000c:C-2, C-3). Historically, RPL has generated an average of 1.13 million liters (300,000 gallons) of sanitary wastewater annually and 2.27 million liters (600,000 gallons) of process wastewater per year (DOE 1997c: 4-58). RPL currently generates an average of 3.98 million liters (1.05 million gallons) of sanitary wastewater annually and 3.6 million liters (950,000 gallons) per year of process wastewater (DOE 2000c:C-3; Tenforde 2000). Liquid, low-level radioactive waste generation has averaged less than 3,800 liters (1,000 gallons) per year (DOE 1997c:4-58, 4-59). Building 306–E is also served by the sanitary sewer and process sewer systems. For Building 306–E, sanitary wastewater generation averages 995,000 liters (262,000 gallons) on an annual basis and process wastewater generation averages 24.9 million liters (6.57 million gallons) per year (Tenforde 2000). Process wastewater with the potential for radioactive contamination is not routinely generated at the facility (DOE 1997c:4-60, B.2-2). Waste management activities and facilities are discussed in greater detail under Section 3.4.11.

#### 400 AREA

The 400 Area is located 6.3 kilometers (3.9 miles) from the west bank of the Columbia River. No specific flooding analyses have been completed for the 400 Area, but analyses have been completed for the site as a whole. According to the sitewide data, the elevation of the ground surface in the 400 Area is about 30 meters (100 feet) above that of the maximum calculated flood from a 50 percent breach of the Grand Coulee Dam (Mecca 1997a:4) (Figure 3–15). Also, the 400 Area is above the elevation of the maximum historical floods of 1894 (Neitzel 1999:4.61) and 1948 (Figure 3–14).

The only surface water body in the vicinity of the 400 Area is the 400 Area Pond (i.e., FFTF Pond or 4608 B/C ponds) located just north of the 400 Area (DOE 1999k:4-31; Neitzel 1999:4.67). It is designed and used to dispose of nonradioactive process wastewater collected by the process sewer system from four 400 Area facilities including FFTF, FMEF, the Maintenance and Storage Facility, and the water pumphouse. The

400 Area Pond consists of two cells measuring 15 by 30 meters (50 by 100 feet) with 1.2-meter (4-foot) walls. The majority of the wastewater discharged to the pond system is cooling tower blowdown from FFTF's eight auxiliary cooling towers and FMEF's three cooling towers (currently inactive). Individual effluent streams are collected at a central drain line that runs to the ponds, with the effluent monitored before discharge. Wastewater rapidly percolates into the ground, leaving the ponds dry under normal conditions. The discharges are regulated under State Waste Discharge Permit No. ST-4501, and the effluent is periodically sampled and analyzed for permit compliance. Approximately 76 million liters (20 million gallons) per year of process wastewater is discharged to the ponds. Also, about 3.8 million liters (1 million gallons) of sanitary wastewater is discharged annually from 400 Area facilities to the Energy Northwest system for treatment (DOE 2000c:11; Nielsen 1999:38, 39, 41). There are no radiological liquid effluent pathways to the environment from either FFTF or FMEF under normal operations (DOE 1997c:4-6, 4-29). Liquid, low-level radioactive waste from equipment washing is generated during standby operations at a maximum rate of about 3,785 liters (1,000 gallons) per year. It is collected in tanks and transported to the 200 Area Effluent Treatment Facility for treatment and disposal (DOE 1997c:4-54; Nielsen 1999:39).

FMEF is also equipped with a separate retention/radioactive liquid waste system for handling wastewater not conveyed to the sanitary system due to the slight potential for radioactive contamination of some wastewater streams. Wastewater first flows to two 22,700-liter (6,000-gallon) collection tanks, where the wastewater can be sampled and either discharged by operator command to the process sewer system or, if contaminated, can be trucked to the 200 Area Effluent Treatment Facility, or other suitable facility, for processing (DOE 1997c:B.1-11; 2000c:7). Waste management activities and facilities are discussed in greater detail under Section 3.4.11.

#### **3.4.4.2 Groundwater**

Aquifers are classified by Federal and state authorities according to use and quality. The Federal classifications include Classes I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Classes IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

##### **3.4.4.2.1 General Site Description**

Groundwater under Hanford occurs in confined and unconfined aquifer systems. The hydrostratigraphic (water bearing) units comprising these systems are illustrated in **Figure 3-16**. The unconfined aquifer system, referred to as the suprabasalt aquifer system, lies within the glacioalluvial sands and gravels of the Hanford Formation and, to a greater degree, the fluvial and lacustrine sediments of the Ringold Formation. Groundwater generally flows eastward across the site from recharge areas in the higher elevations on the western site boundary, with discharge primarily to the Columbia River (**Figure 3-17**) (DOE 1999e:3-31; Neitzel 1999:4.68). The Yakima River is also considered a source of recharge (Neitzel 1999:4.68). Because of site wastewater disposal practices, however, the water table has risen as much as 27 meters (89 feet) in the 200 West Area. This has caused groundwater mounding with radial and northward flow components in the 200 Area, although groundwater elevations have declined since 1984 due to decreased wastewater disposal (DOE 1999e:3-31; Neitzel 1999:4.70). Depth to groundwater across the site ranges from 0.3 meters (1 foot) along the Columbia River to more than 106 meters (348 feet) near the center of the site (Dirkes, Hanf, and Poston 1999:6.10). Daily river level fluctuations may result in water table fluctuations of up to 3 meters (10 feet) near the Columbia River (Neitzel 1999:4.68).

Age		Group	Sub-group	Formation	Sediment Stratigraphy, Member, or Sequence						Hydrologic Unit
QUATERNARY	Holocene				Loess	Sand Dunes	Alluvium and Alluvial Fans	Landslides	Talus	Colluvium	Unconfined Aquifer System
	Pleisto-cene			Hanford	Hanford Formation						
	Plio-cene				Early "Palouse" Soil/Plio-Pleistocene Unit						
TERTIARY	Miocene	Columbia River Basalt Group		Ringold	Ringold Formation		Fanglomerate				Ellensburg Formation (Interbeds) Confined Aquifer System
				Saddle Mountains Basalt	Ice Harbor Member						
					Levey Interbed						
					Elephant Mountain Member						
					Rattlesnake Ridge Interbed						
					Pomona Member						
					Selah Interbed						
					Esquatzel Member						
					Cold Creek Interbed						
					Asotin Member						
		Wilbur Creek Member									
		Umatilla Member									
		Wanapum Basalt	Mabton Interbed								
			Priest Rapids Member								
			Quincy Interbed								
			Roza Member								
		Grande Ronde Basalt	Squaw Creek Interbed								
			Frenchman Springs Member								
			Vantage Interbed								
		Sentinel Bluffs Sequence									
		Schwana Sequence									

Source: Modified from Neitzel 1999.

Source: Modified from Neitzel 1999.

Figure 3–16 Stratigraphic Column for the Pasco Basin and Hanford Site

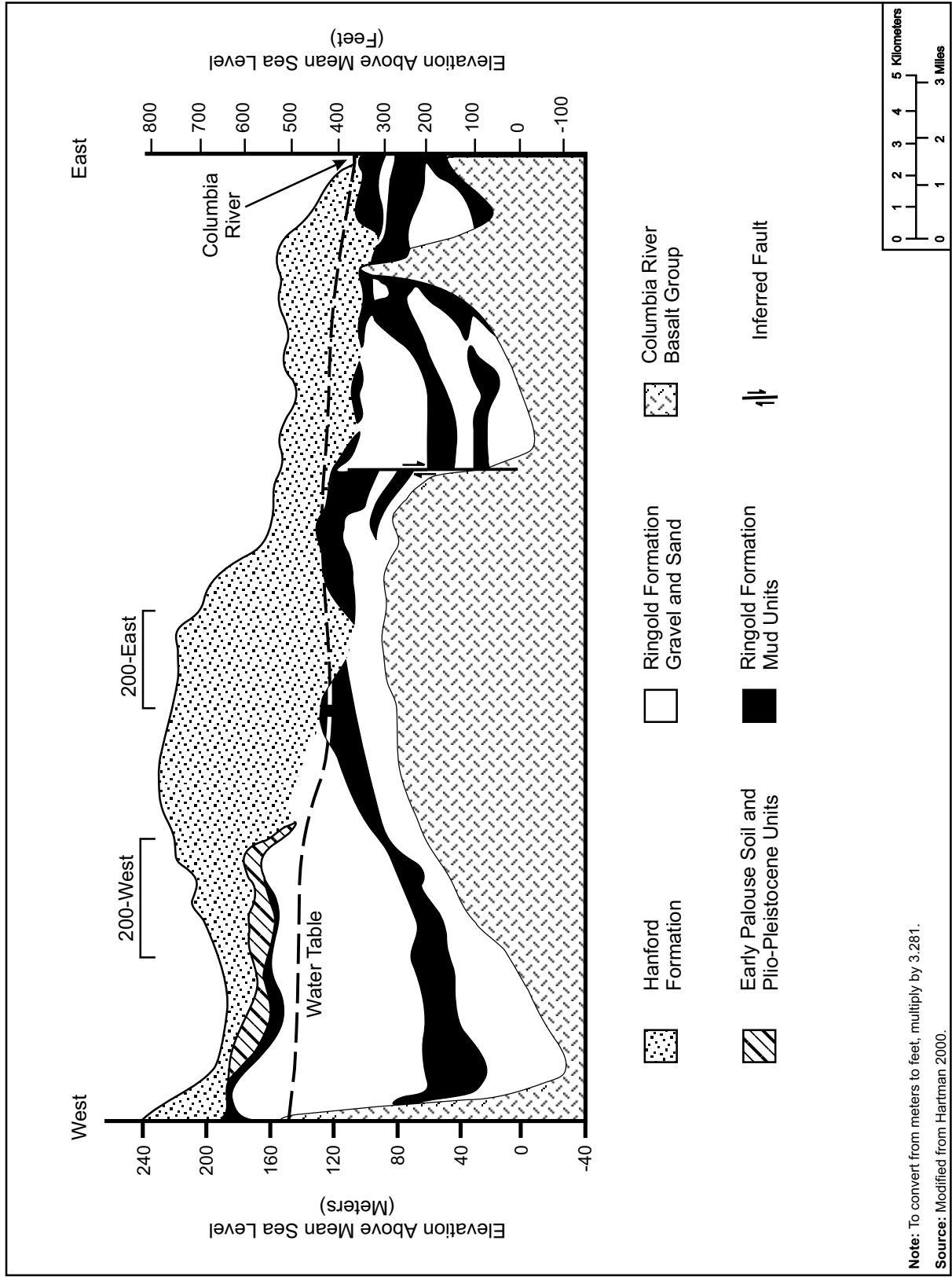


Figure 3-17 Geologic Cross Section of the Hanford Site

The confined aquifer system at Hanford consists of sedimentary interbeds and interflow zones that occur between basalt flows in the Columbia River Basalt Group. Aquifer thickness varies from several centimeters to at least 52 meters (171 feet). Recharge of the confined aquifer occurs where the basalt formations are near ground level, and thus surface water is allowed to infiltrate them. Groundwater in the confined aquifer system discharges to the Columbia River, but in some places, moves toward areas of vertical interconnection with the overlying unconfined aquifer system. One such area is near the Gable Mountain anticline (DOE 1999e:3-32; Neitzel 1999:4-68).

Water use in the Pasco Basin, which includes Hanford, is primarily via surface water diversion; groundwater accounts for less than 10 percent of water use (DOE 1999k:4-49). While most of the water used by Hanford is surface water withdrawn from the Columbia River, some groundwater is used. One of the principal users of groundwater was FFTF, which used about 697,000 liters (184,000 gallons) per day when it operated. In addition to the 400 Area, other facilities that use groundwater are the Yakima Barricade and the Patrol Training Academy (Barghusen and Feit 1995:2.2-22). DOE currently asserts an unlimited federally reserved groundwater withdrawal right with respect to existing Hanford operations, and withdraws about 197 million liters (52 million gallons) per year (DOE 1999e:3-32).

Groundwater quality beneath large portions of the Hanford Site has been affected by past liquid waste discharges, primarily to ditches, trenches, and ponds and from spills, injection wells, and leaks from waste storage tanks (Neitzel 1999:4.72). The unconfined aquifer system contains radiological and nonradiological contaminants at levels exceeding water quality criteria and standards. During fiscal year 1999 (October 1998 to September 1999), 623 wells were sampled for radiological and chemical constituents. Tritium and iodine-129 are the most widespread radiological contaminants in the unconfined aquifer system, with tritium exceeding the drinking water standard in the 100, 200, 400, and 600 Areas in 1998 and fiscal year 1999. Tritium levels are expected to decrease over time because of dispersion and radioactive decay. Nitrate, chromium, and carbon tetrachloride are the most widely distributed nonradiological contaminants (Dirkes, Hanf, and Poston 1999:6.27, 6.49; Hartman, Morasch, and Webber 2000:2.5–2.8). Tritium, iodine-129, and nitrate are the most widespread groundwater contaminants associated with Hanford legacy activities. Their distribution in the unconfined aquifer system are illustrated in **Figures 3–18, 3–19, and 3–20**, respectively. The figures also depict the locations of former waste management sites (e.g., Gable Mt. Pond, U Pond, B Pond, effluent disposal cribs) and burial grounds. Also shown are locations of active waste management and treatment facilities such as the State Approved Land Disposal Site, the Effluent Treatment Facility, the 200 Areas TEDF, and the Environmental Restoration Disposal Facility. Information on groundwater monitoring and chemical analysis is summarized in the annual site environmental report with detailed results in the site groundwater monitoring report (Dirkes, Hanf, and Poston 1999; Hartman, Morasch, and Webber 2000). Contamination in the confined aquifer system is typically limited to areas of exchange with the unconfined aquifer system (Dirkes, Hanf, and Poston 1999:6.65). No aquifers have been designated sole-source aquifers (Barghusen and Feit 1995:2.2-22).

#### **3.4.4.2.2 Locations of Proposed Activities**

##### **300 AREA**

Groundwater flow direction and the water table in the unconfined aquifer system beneath the 300 Area are greatly affected by fluctuations in the level of the Columbia River. During low to average river level conditions, groundwater in the unconfined aquifer system converges beneath the 300 Area from the northwest and southwest and flows in a west to east or northwest to southeast direction, with discharge to the river. High river flows cause the water table to rise above the Hanford-Ringold formation contact and groundwater temporarily flows in a generally southwest to south direction. The unconfined aquifer system consists mainly of Hanford Formation gravels and sands, and Ringold Formation gravels and sands with varying amounts of

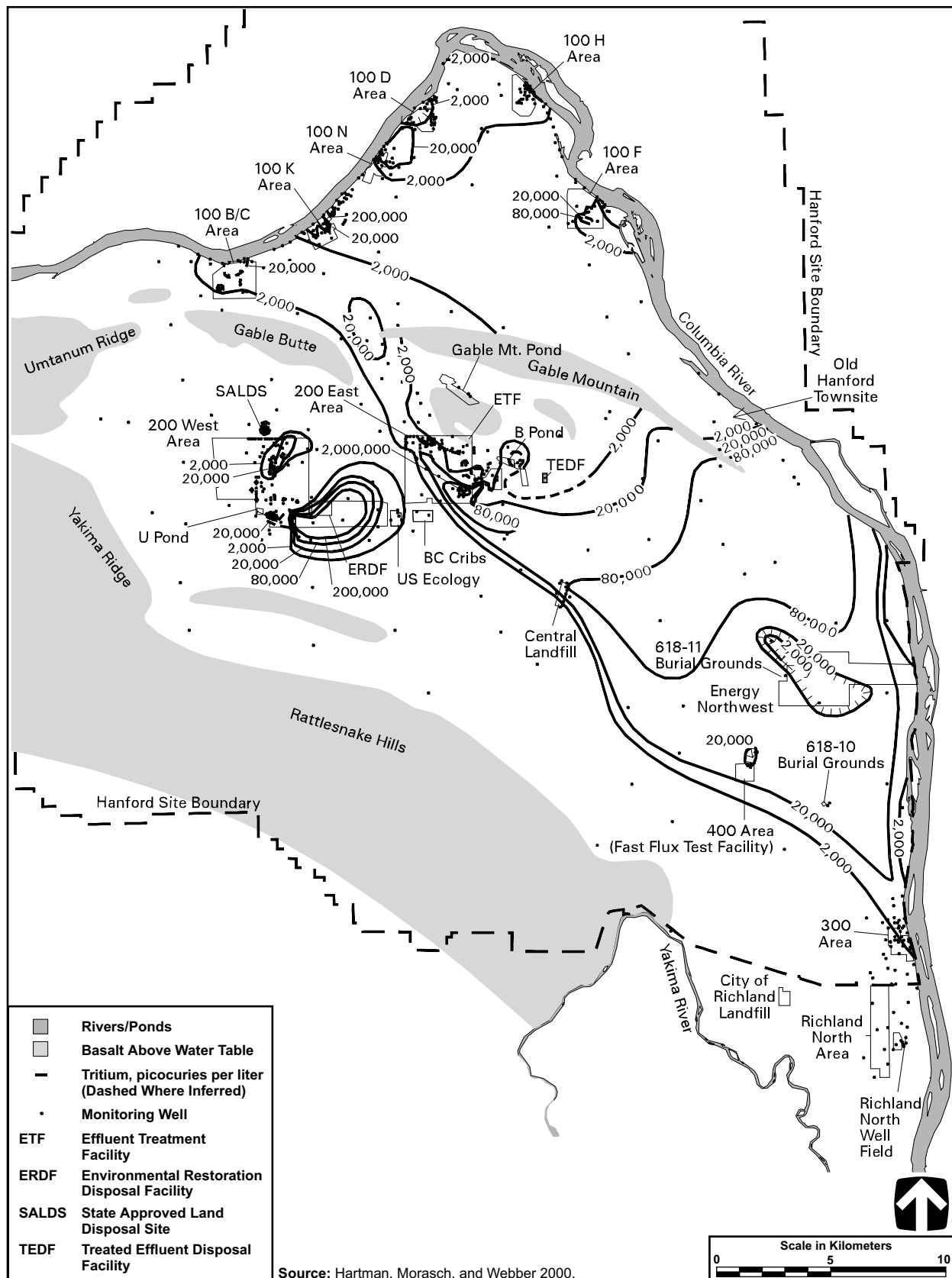


Figure 3-18 Average Tritium Concentrations on the Hanford Site, Top of Unconfined Aquifer

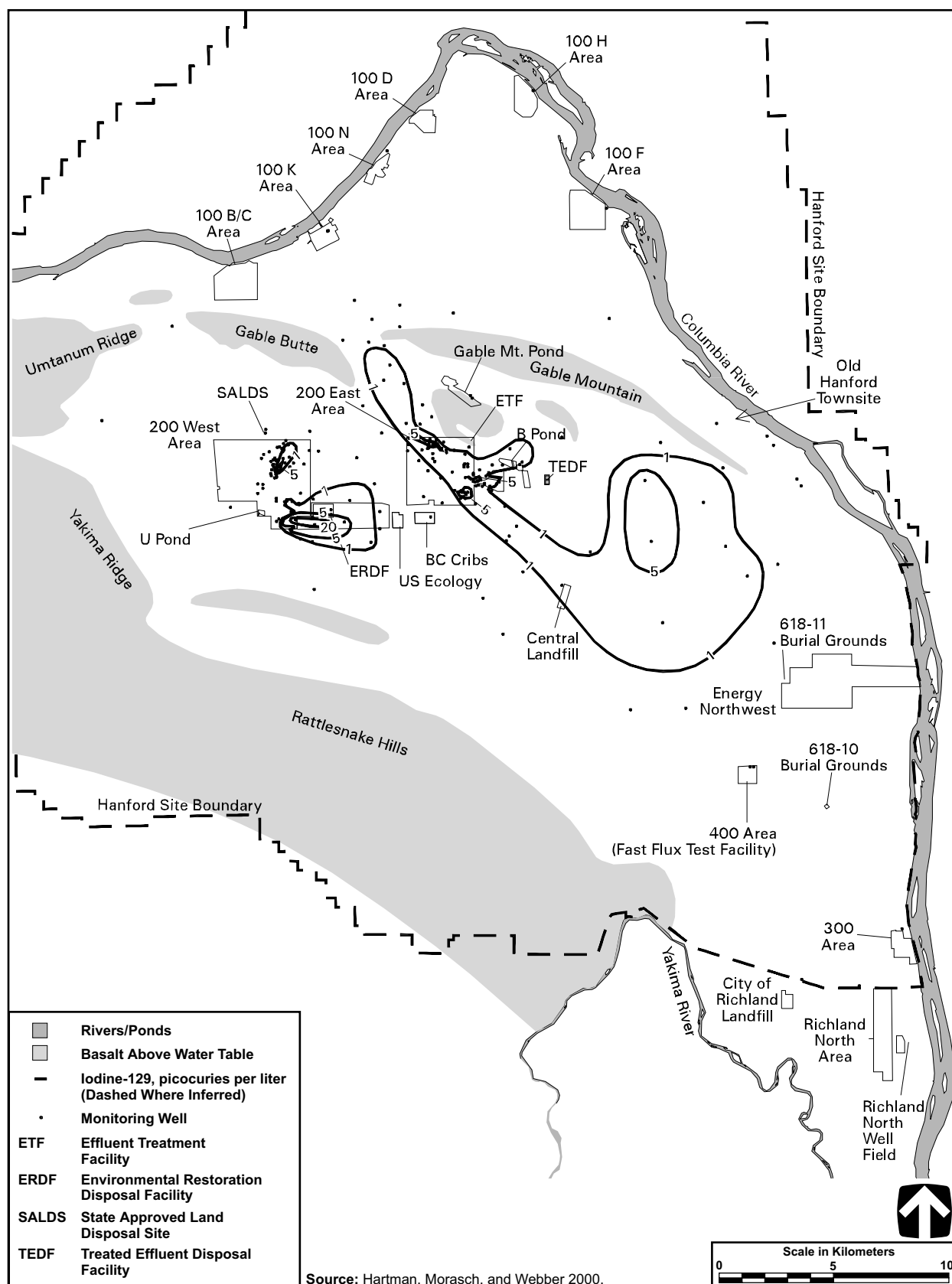


Figure 3-19 Average Iodine-129 Concentrations on the Hanford Site, Top of Unconfined Aquifer

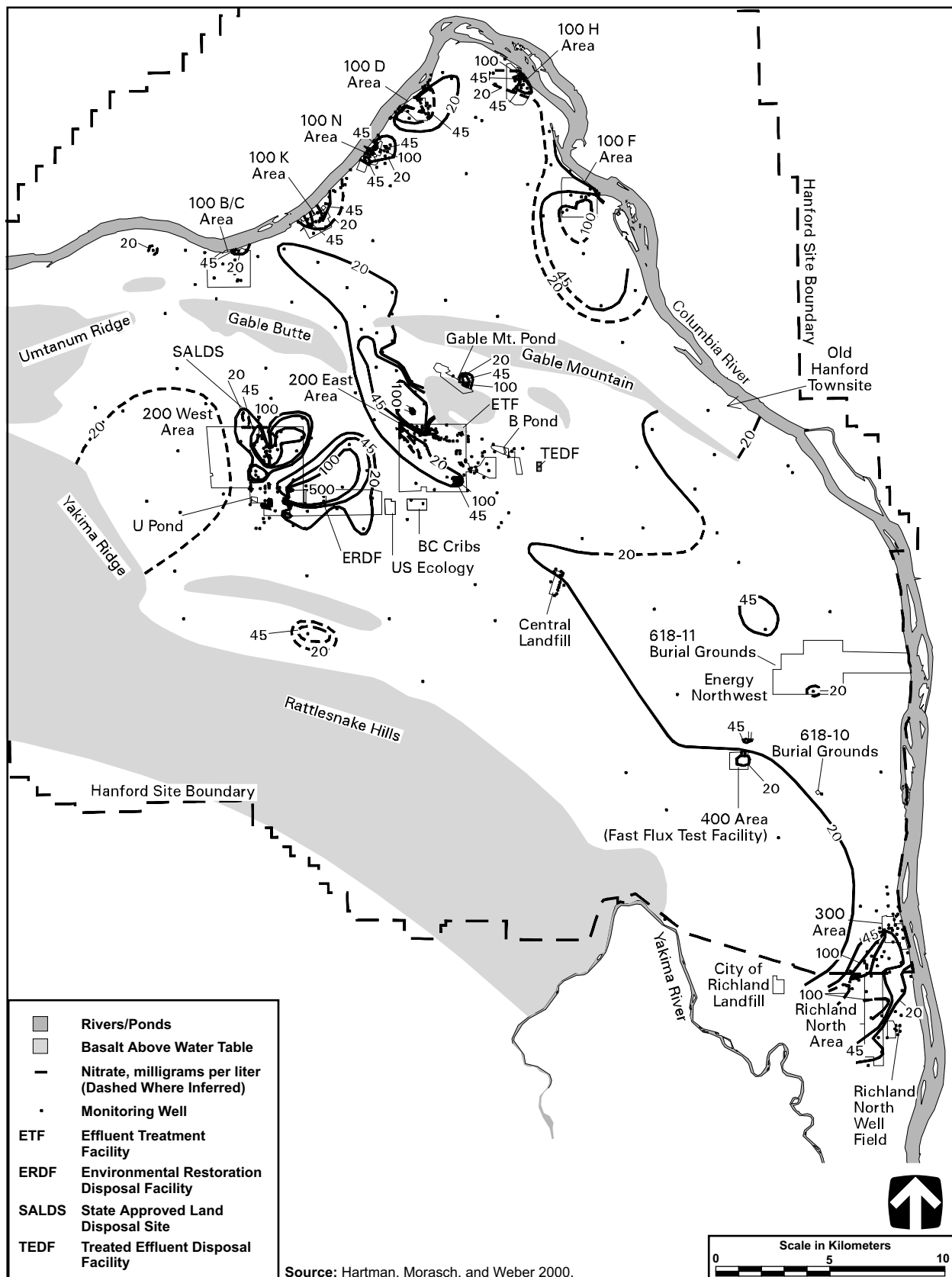


Figure 3-20 Average Nitrate Concentrations on the Hanford Site, Top of Unconfined Aquifer

silt and clay. The water table lies within the Hanford Formation in most of the 300 Area. The depth to the water table beneath the 300 Area ranges from less than 1 meter (3 feet) near the Columbia River to 18 meters (59 feet) further inland (Hartman 2000:4.27, 4.28).

Groundwater quality in the 300 Area has primarily been affected by the uranium fuel fabrication facility and related cooling and sanitary wastewater discharges to the former 316-1 and 316-2 process ponds and subsequently to the 316-5 process trenches (Hartman 2000:4.28, 4.29). Uranium is the major contaminant of concern in the 300 Area with a plume in the upper unconfined aquifer system extending from the northeast and north-central portions of the 300 Area and south and east across the area to the Columbia River. In fiscal year 1999, uranium was detected at levels above the proposed drinking water maximum contaminant level (20 micrograms per liter) over much of the northeastern and eastern parts of the 300 Area, with a high of 322 micrograms per liter detected in one well (Hartman, Morasch, and Webber 2000:2.256, 2.260). Other groundwater contaminants detected at levels above their maximum contaminant levels (5 and 70 micrograms per liter, respectively) in the bottom of the unconfined aquifer system in the 300 Area during 1999 include trichloroethylene and cis-1,2-dichloroethylene in one well, with concentrations of 6 and 180 micrograms per liter, respectively. Tetrachloroethylene was detected above the maximum contaminant level (5 micrograms per liter) in one well in the upper part of the unconfined aquifer east and southeast of the 316-5 process trenches at a concentration of 7 micrograms per liter. Nitrate was above the maximum contaminant level (45 milligrams per liter) in two wells in the southern and southwestern portions of the 300 Area, with a maximum concentration of 110 milligrams per liter. This contaminant has been attributed to offsite industry and agriculture. The southward migrating tritium plume originating in the 200-East Area has also impacted the unconfined aquifer in the 300 Area, but with levels below the interim drinking water standard of 20,000 picocuries per liter (Hartman, Morasch, and Webber 2000:2.255, 2.257, 2.258, 2.265, 2.267, A-78).

#### 400 AREA

Groundwater flow across the 400 Area is generally from west to east. The Hanford Formation immediately underlying the area consists mainly of the sand-dominated sediments. The water table is located near the contact between the Hanford and Ringold Formations, with the depth to the water table in the 400 Area ranging from about 45 to 50 meters (148 to 164 feet). Hanford Formation sediments dominate groundwater flow in the 400 Area because of their relatively high permeability, compared to that of the Ringold Formation sediments. The Ringold Formation consists of gravelly sands, sandy gravel, silty sands and fluvial gravels and overbank and lacustrine silt and clay. The saturated thickness of this aquifer system is about 140 meters (460 feet) (Hartman 2000:4.25).

The 400 Area receives its water from three supply wells, each with a pumping capacity of 833 liters (220 gallons) per minute (FDH 1999:3-4). One well (499-S1-8J) serves as the primary supply well for all 400 Area needs, including potable, process, and fire protection uses. The second and third wells (499-S0-8 and 499-S0-7) provide backup and emergency supply, respectively. Chlorination is the only water treatment provided to these wells (FDH 1999:4; Dirkes, Hanf, and Poston 1999:4.48, 4.49, 6.8). All of the wells are completed in the unconfined (Hanford/Ringold) aquifer system. The primary production well was installed in 1985 in the lower unconfined aquifer system after tritium contamination was detected in the original two wells, completed near the top of the aquifer (Hartman 2000:4.25). Water usage in the 400 Area ranges from about 284 to 681 liters (75 to 180 gallons) per minute on a seasonal basis. Water is stored in three aboveground storage tanks with a total capacity of about 3 million liters (800,000 gallons) (FDH 1999:4). Average annual groundwater use in the 400 Area is currently about 197 million liters (52 million gallons) (Nielsen 1999:41).

Nitrate is the only significant contaminant attributable to 400 Area operations. Elevated nitrate concentrations in excess of the drinking water maximum contaminant level have been attributed to the former sanitary sewage

lagoon located west and upgradient of the 400 Area process ponds. The maximum concentration in fiscal year 1999 was 92 milligrams per liter; the maximum contaminant level is 45 milligrams per liter. As disposal to the lagoon has been discontinued and the lagoon backfilled, nitrate contamination from this source should diminish with time. Elevated levels of tritium in 400 Area wells continued in 1999 and are associated with the groundwater plume from the vicinity of the Plutonium Uranium Extraction Plant in the 200-East Area. Tritium was found at levels at or above the interim drinking water standard (20,000 picocuries per liter) in samples from the 400 Area backup supply wells (wells 499-S0-7 and 499-S0-8). The maximum in the backup water supply in fiscal year 1999 was 68,400 picocuries per liter (Hartman, Morasch, and Webber 2000:2.8, 2.235, 2.236). All samples collected from the primary supply well (499-S1-8J) were below the drinking water standard for tritium. Tritium activities were also below the drinking water standard, and the 4-millirem-per-year dose equivalent in the drinking water supply (sampled at the tap), for all sampling events in fiscal year 1998. Nitrate levels also remained below the maximum contaminant level in fiscal year 1999 for the water-supply wells. Fiscal year 1999 and past data from 400 Area and surrounding wells indicates no other constituents are present at levels above drinking water maximum contaminant levels (Hartman, Morasch, and Webber 2000:2.236).

One recent finding based on groundwater monitoring for nearby areas is particularly noteworthy with regard to tritium concentrations near the 400 Area. In January 1999, a sample from well 699-13-3A, located along the eastern (downgradient) fence line of the 618-11 burial ground and about 4 kilometers (2.5 miles) southeast of the 400 Area, contained 1.86 million picocuries per liter of tritium. The result was confirmed via reanalysis and represents the first time that tritium has been detected in this well. This value is also much higher than data from the surrounding wells. A January 2000 sample contained 8.1 million picocuries per liter of tritium. This is the highest concentration of tritium detected onsite in recent years. A special investigation of the groundwater at the 618-11 burial ground was to be undertaken in fiscal year 2000 to determine the source of the high tritium results (Hartman, Morasch, and Webber 2000:2.246). The results should be available in time to be published in the fiscal year 2000 groundwater monitoring report.

### **3.4.5 Geology and Soils**

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

#### **3.4.5.1 General Site Description**

Hanford lies within the Pasco Basin of the Columbia Plateau that is encompassed by the Columbia Intermontane physiographic province (Barghusen and Feit 1995:2.2-12). The rocks beneath Hanford consist of Miocene age (5 to 24 million years old) and younger rocks that overlay older Cenozoic sedimentary and volcanic basement rocks. The major geologic units underlying Hanford are, in ascending order: subbasalt (basement) rocks; the Columbia River Basalt Group; and the Ringold Formation, the Plio-Pleistocene unit, early "Palouse" soil, and the Hanford Formation, collectively known as the Suprabasalt Sediments (Figures 3-16 and 3-17).

The Columbia River Basalt Group consists of sequences of continental flood basalts of Miocene age that cover an extensive area across Washington, Oregon, and Idaho. Nearly all of the flood basalts were erupted in a span dating from approximately 14.5 to 17 million years ago. Volcaniclastic (volcanic-sedimentary) and fluvial (stream deposited) sedimentary materials of the Ellensburg Formation are interbedded within the group. Airfall tuff (consolidated volcanic ash) is the dominant volcaniclastic material at the Hanford Site. The Ringold Formation is exposed in the White Bluffs east of the Columbia River on the site and consists of sedimentary deposits dominated by fluvial gravel and sand deposits along with lake-deposited sand, silt, and

clay. The Plio-Pleistocene unit is locally derived, consisting of alluvium, colluvium, and/or calcium-cemented soil material (caliche). Wind-deposited sand and silt characterizes the early “Palouse” soil. This unit occurs in the western portion of the site. Because it is hard to distinguish from overlying and underlying units, it is generally grouped together with the Plio-Pleistocene unit. Gravel, sand, and silt deposits, comprising the unit informally designated as the Hanford Formation, are the products of cataclysmic floods that inundated the Pasco Basin and the Hanford Site during the Pleistocene between about 13,000 and 1 million years ago. Younger surficial materials also include alluvium deposited by streams and rivers, as well as active sand dune fields (i.e., north of Energy Northwest) (DOE 1999k:4.12–4-22; Hartman 2000:3.1–3.4; Neitzel 1999:4.35–4.44).

Basalt outcrops are exposed on ridges at Gable Mountain, Gable Butte, and the Saddle Mountains in the northern part of Hanford, and on Rattlesnake Hills and Yakima Ridge, overlapping the western and southwestern edges of the site. Other than crushed rock, sand, and gravel, no economically viable geologic resources have been identified at Hanford (DOE 1999e:3-24).

Known faults in the Hanford area include those on Gable Mountain and the Rattlesnake-Wallula alignment. The faults in Central Gable Mountain are considered capable, although there is no observed seismicity on or near Gable Mountain. The Rattlesnake-Wallula alignment is interpreted as possibly being capable because there appear to be active portions of the fault system 56 kilometers (35 miles) southwest of the central part of Hanford (Barghusen and Feit 1995:2.2-13, 2.2-14). A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years, or recurrent movement within the past 500,000 years (10 CFR Part 100, Appendix A).

Seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is lower than that of other regions in the Pacific Northwest. The two largest earthquakes near Hanford occurred in 1918 and 1973; each had an approximate Richter magnitude of 4.4 and a Modified Mercalli Intensity of V (Table 3–3). They occurred in the central portion of the Columbia Plateau north of Hanford, with the December 20, 1973, event epicentered approximately 22 kilometers (14 miles) northwest of the Hanford Site boundary (Neitzel 1999:4.52; USGS 2000c). There have been 45 small earthquakes (ranging in magnitude from 2.5 to 3.9) recorded within a radius of 90 kilometers (56 miles) of the Hanford Site 400 Area since the 1973 earthquake. The closest of these was a magnitude 3.3 event that occurred on June 12, 1995, and had an epicenter about 8 kilometers (5 miles) southeast of the 400 Area (Chapin 2000; USGS 2000c). Based on the most recent seismic analyses, an earthquake with a maximum horizontal acceleration of 0.2g is calculated to have an annual probability of occurrence of 1 in 2,500 at Hanford (Neitzel 1999:4.55). While evidence has been mounting since at least the early 1990s that great earthquakes, with a magnitude of 8 to 9, have occurred in the past in association with the Cascadia Subduction Zone off the coast of the Pacific Northwest, the increased risk is primarily to Western Washington (USGS 1995).

As discussed in more detail in Section 3.2.5.1, USGS has developed new seismic hazard maps as part of the National Seismic Hazard Mapping Project that are based on response spectral acceleration. These maps have been adapted for use in the new *International Building Code* (ICC 2000) (Figures 1615 (1) and 1615(2) in the code) and depict maximum considered earthquake ground motion of 0.2- and 1.0-second spectral response acceleration, respectively, based on a 2 percent probability of exceedance in 50 years. Hanford lies within the 0.40g to 0.50g mapping contours for a 0.2-second spectral response acceleration and the 0.10g to 0.15g contours for a 1.0-second spectral response acceleration.

There is some potential for slope failure at Hanford, although only the slopes of Gable Mountain and White Bluffs are steep enough to warrant landslide concern. White Bluffs, east of the Columbia River, poses the greatest concern. This risk is in part attributable to the largely unconsolidated and uncemented nature of the

Ringold sediments comprising much of the bluffs, the discharge of irrigation water atop the bluffs and subsequent percolation through the sediments, and the general dip of the sediments toward the Columbia River (DOE 1999k:4-18, 4-21; Neitzel 1999:4.43). A large landslide along White Bluffs could fill the Columbia River channel and divert water onto Hanford. Calculations of the potential impacts of such a landslide indicate a flood area similar to the probable maximum flood (Neitzel 1999:4.64, 4.65).

Several major volcanoes are in the Cascade Range west of Hanford, including Mount Adams and Mount St. Helens, located 165 kilometers (102 miles) and 220 kilometers (137 miles) from the site, respectively. Ashfalls from at least three Cascade volcanoes have blanketed the central Columbia Plateau since the late Pleistocene epoch. Generally, ashfall layers have not exceeded more than a few centimeters (less than 1.5 inches) in thickness, with the exception of the Mount Mazama (Crater Lake, Oregon) eruption, when as much as 10 centimeters (3.9 inches) of ash fell over western Washington (Barghusen and Feit 1995:2.2-14).

Fifteen different soil types occur at Hanford. These soils vary from sand to silty and sandy loam. The dominant soil types are the Quincy (Rupert) sand, Burbank loamy sand, Ephrata sandy loam, and the Warden silt loam. No soils at Hanford are currently classified as prime farmlands because there are no current soil surveys, and the only prime farmland soils in the region are irrigated. The Quincy (Rupert) sand is the most widespread soil type at Hanford, but particularly encompasses much of the southeast and east-central portions of the site (south and east of the 200 Areas). It developed from sandy alluvial deposits mantled by wind-blown sand. Burbank loamy sand soils mainly occur north of the 200 Areas and south of the Columbia River along with Ephrata sandy loams. Both soils are underlain by gravelly material. The Warden silt loam occurs in a broad band in the south and southwestern portions of the site, running from the south boundary of the site and downslope of Rattlesnake Mountain (DOE 1999k:4.23–4.27; Neitzel 1999:4.48–4.51). More detailed descriptions of the geology and the soil conditions at Hanford are included in the *Hanford Site NEPA Characterization* (Neitzel 1999) and the *Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 1999k).

### **3.4.5.2 Locations of Proposed Activities**

#### **300 AREA**

The Central Gable Mountain fault is the nearest capable fault to the 300 Area and is located 28 kilometers (17 miles) away (DOE 1999k:4-19; Mecca 1997a:6, 78, 79). The surficial stratigraphy of the 300 Area is dominated by the gravel and sands of the Hanford Formation that overlie the sediments of the Ringold Formation. Total thickness of these units is approximately 52 meters (171 feet) (Hartman 2000:4.27, 4.28; Neitzel 1999:4.45). The predominant soil type is the Quincy (Rupert) sand, and the soils and surface sediments are not subject to liquefaction or other instabilities (Mecca 1997a:6; Neitzel 1999:4.49).

#### **400 AREA**

The nearest capable fault to the 400 Area (Central Gable Mountain fault) is 19 kilometers (12 miles) away (Mecca 1997a:6, 78, 79). 400 Area stratigraphy consists of sand-dominated sediments of the Hanford Formation which attain a thickness of about 50 meters (164 feet) beneath the site. Locally, surface sediments also consist of stabilized sands deposited in dune fields (Hartman 2000:4.25; Neitzel 1999:4.44). The predominant soil type in the 400 Area is the Quincy (Rupert) sand, and the soils and surface sediments are not subject to liquefaction or other instabilities (Mecca 1997a:6; Neitzel 1999:4.49).

### 3.4.6 Ecological Resources

Ecological resources include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Material presented in this section, unless otherwise noted, is from the *Storage and Disposition PEIS* (DOE 1996b:3-83-3-87).

#### 3.4.6.1 Terrestrial Resources

This section addresses the plant and animal communities of Hanford and includes a plant community map of the site. Terrestrial resources are described for the site as a whole, as well as for the proposed facility locations.

##### 3.4.6.1.1 General Site Description

Vegetation at Hanford has been characterized as shrub-steppe. Shrub-steppe ecosystems are typically dominated by a shrub overstory with a grass understory. Present site development consists of clusters of large buildings that are found at widely spaced locations. Developed areas encompass about 6 percent of the site. The remaining areas of the site can be divided into 10 major plant communities (**Figure 3–21**). Hanford is dominated by plant communities in which big sagebrush is a major component. Other plant communities contain a variety of grasses and herbaceous plants. Areas previously disturbed by agricultural activities are dominated by nonnative species, such as cheatgrass. Trees are uncommon on the site, but those that are present include cottonwood and willow, which are both found near water bodies, and a few other deciduous species which were originally planted near farmsteads as windbreaks. Five hundred ninety species of plants have been identified at Hanford (Neitzel 1999).

Unique habitats on the Hanford Site include bluffs, dunes, and islands within the Columbia River. The White Bluffs, Umtanum Ridge, and Gable Mountain include rock outcrops that occur infrequently on the site. Vegetation on basalt outcrops includes snow buckwheat and Sandberg's bluegrass. The terrain of the dune habitat rises and falls between 3 and 5 meters (10 and 16 feet). The dune are vegetated by bitterbrush, dune scurfpea, and thickspike wheatgrass. Riparian vegetation that characterizes the islands of the Columbia River includes willow, white mulberry, snow buckwheat, lupine, yarrow, and thickspike wheatgrass among others (Neitzel 1999).

Hanford provides suitable habitat for numerous animal species, including over 1,500 species of insects, 4 species of amphibians, 9 species of reptiles, 246 species of birds, and 40 species of mammals. Grasshoppers and darkling beetles are among the more conspicuous groups of insects, and along with other insects, are an important food source for local birds and mammals (Neitzel 1999:4.87). Common animal species at Hanford include the side-blotched lizard, gopher snake, western meadowlark, horned lark, Great Basin pocket mouse, black-tailed jackrabbit, and mule deer. Trees planted around former farmsteads serve as nesting platforms for several species of birds, including hawks, owls, ravens, magpies, and great blue herons; these trees also serve as night roosts for bald eagles. The Hanford Reach of the Columbia River, including several sparsely vegetated islands, provides nesting habitat for the Canada goose, ring-billed gull, Forster's tern, and great blue heron. Several game animals are found at Hanford. Hunting is permitted on site north of the Columbia River. Numerous raptors, such as the Swainson's hawk and red-tailed hawk, and carnivores, such as the coyote and bobcat, are found on Hanford. A variety of migratory birds have been found at Hanford.

Unique habitats on the Hanford Site provide habitat for a number of species of wildlife. Bluff areas provide nesting habitat for prairie falcons, red-tailed hawks, and several species of swallows and roosting habitat for bald eagles. Mule deer, burrowing owls, and coyotes, as well as many transient species, may be found in dune habitat. Islands in the Columbia River provide nesting habitat for Canada geese, California gulls, ring-billed gulls and Forster's tern (Neitzel 1999).

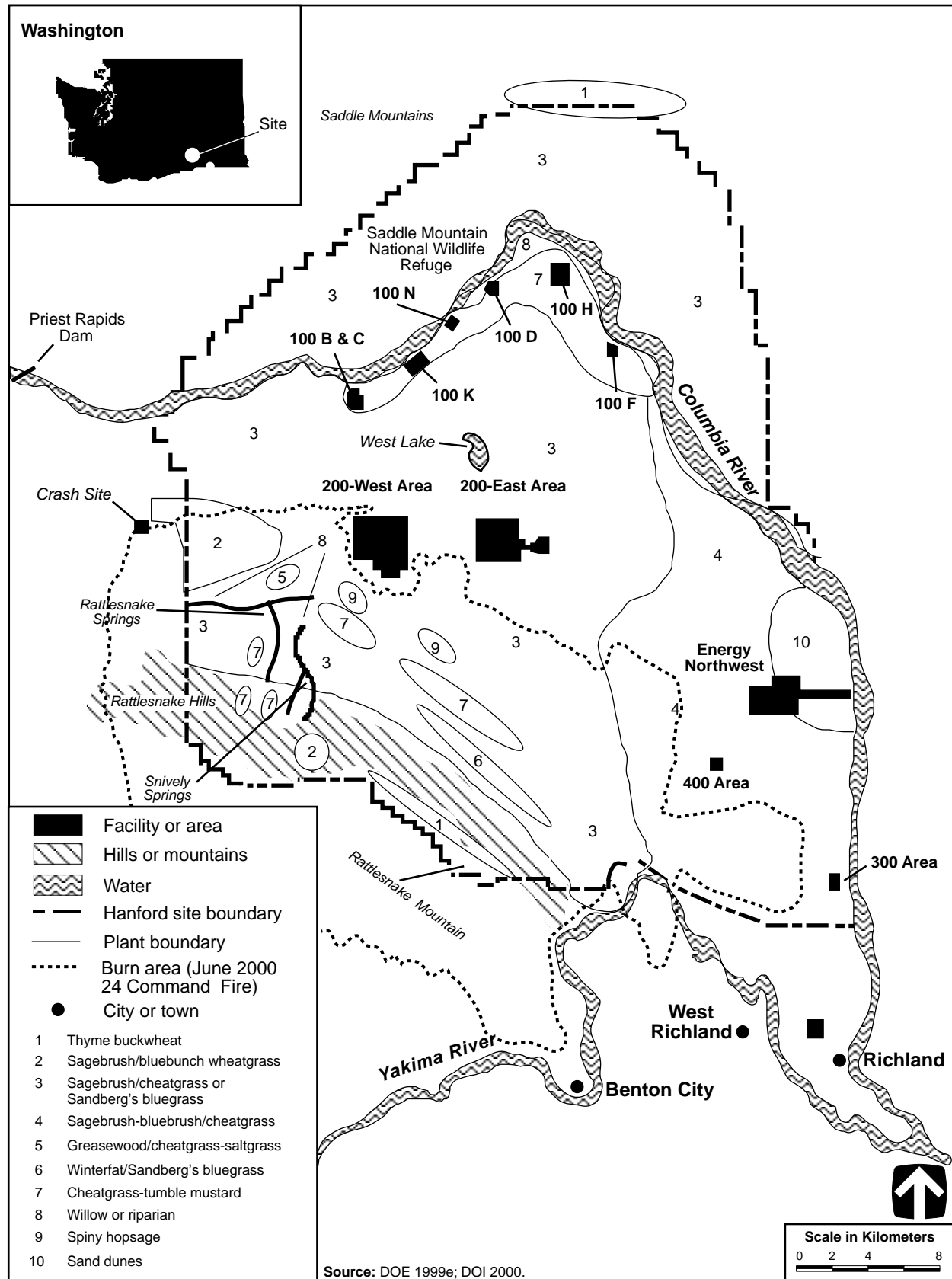


Figure 3-21 Distribution of Plant Communities at the Hanford Site

On June 27, 2000, a fire known as the 24 Command Fire was started by a fatal motor vehicle accident on State Route 24, about 2 miles west of the State Route 240 intersection. As a result of high winds and temperatures and low humidity, the fire spread rapidly and eventually consumed 66,322 hectares (163,884 acres) of Federal, state, and private lands. A total of 24,384 hectares (60,254 acres) within Hanford burned, including lands within the Hanford Reach National Monument, most of the Arid Lands Ecology Reserve, and areas near former production sites (Figures 3–12 and 3–21). The fire was declared controlled on July 2, 2000 (DOI 2000).

The USFWS has prepared a *Burned Area Emergency Rehabilitation Plan* in which resource issues and impacts were assessed and recommendations outlined (DOI 2000). Due to the extremely dry conditions and high winds, vegetation resources were significantly reduced on about 85 percent of the fire area. However, because of the relatively fast passage of the fire over any one area, soils showed little damage and seed bank sources in the soil were not adversely impacted. While this will aid natural vegetation, recovery of some plant associations (e.g., sagebrush) may require planting and could take years. Plant associations extensively affected by the fire include those containing big sagebrush, bluebunch wheatgrass, and three-tipped sage. Some riparian vegetation was also impacted. Fire suppression tactics, including construction of firebreaks and backfire operations, also adversely affected plant communities. Potential long-term impacts from the fire include the establishment of noxious weeds and changes in natural plant communities.

The 24 Command Fire had immediate direct impacts on wildlife, including loss of individual animals, especially smaller less mobile species and young of the year, as well as displacement of more mobile animals to unaffected areas. However, displacement itself can lead to an increase in mortality due to road kills, and in the case of elk, this has already occurred. Additionally, long-term impacts to wildlife due to loss of food, cover, and breeding habitat are expected as a result of the fire (DOI 2000).

#### **3.4.6.1.2 Locations of Proposed Activities**

##### **300 AREA**

While the 300 Area is located within the big sagebrush/bunchgrasses–cheatgrass vegetation community, it is heavily developed (DOE 1999k). Vegetation within the 300 Area is characteristic of disturbed areas consisting of sparse amounts of cheatgrass and Russian thistle (Nielsen 2000). Due to the disturbed nature of most of the 300 Area, wildlife use of developed portions of the areas is limited.

##### **400 AREA**

The 400 Area is located within postfire shrub-steppe habitat dominated by cheatgrass and small shrubs, including gray and green rabbitbrush. Due to past disturbances and human occupancy in the 400 Area, wildlife is limited. Several animal species may be found in the area, including the gopher snake, northern Pacific rattlesnake, burrowing owl, Swainson's hawk, western meadowlark, black-tailed jackrabbit, and Great Basin pocket mouse (DOE 1999e:3-35).

#### **3.4.6.2 Wetlands**

Wetlands include “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 CFR Section 328.3). Wetlands are described for Hanford as a whole, as well as for the proposed facility locations.

### **3.4.6.2.1 General Site Description**

Primary wetland areas at Hanford are found in the riparian zone along the Columbia River. The extent of this zone varies, but includes large stands of willows, grasses, and other plants. This area has been extensively affected by hydropower operations at Priest Rapids Dam (Neitzel 1999).

Other large areas of wetlands at Hanford can be found north of the Columbia River within the Saddle Mountain National Wildlife Refuge and the Wahluke Wildlife Unit Columbia Basin Area. These two areas encompass all the lands extending from the north bank of the Columbia River northward to the site boundary and east of the Columbia River down to Ringold Springs. Wetland habitat in these areas consists of fairly large ponds resulting from irrigation runoff. These ponds have extensive stands of cattails and other emergent aquatic vegetation surrounding the open water regions. They are extensively used as nesting sites by waterfowl (Neitzel 1999).

On the western side of Hanford, Rattlesnake Springs supports a riparian zone of 3.0 kilometers (1.9 miles) in length, featuring watercress, bulrush, spike rush, cattail and peachleaf willow. Snively Springs also contains a diverse biotic community similar to Rattlesnake Springs (Neitzel 1999). The 24 Command Fire affected approximately 18 hectares (44 acres) of willow riparian habitat, including areas around Rattlesnake Spring, Snively Canyon, Benson Springs, and the Yakima River (DOI 2000). Several semi-permanent artificial ponds and ditches that receive cooling water or irrigation wastewater are also present on Hanford. These waterbodies provide a source of water for terrestrial animals (Neitzel 1999).

### **3.4.6.2.2 Locations of Proposed Activities**

#### **300 AREA**

The 300 Area is bounded on the eastern side by the Columbia River. The riparian zone bordering the river is the only wetland area associated with the site (Nielsen 2000). The general nature of this zone is discussed in Section 3.4.6.2.1.

#### **400 AREA**

There are no natural wetlands in the 400 Area, although a small cooling and wastewater pond does contain some wetland vegetation. Wildlife species observed using the site include a variety of mammals and waterfowl (DOE 1999e:3-36).

### **3.4.6.3 Aquatic Resources**

Aquatic resources at Hanford are described for the site as a whole, as well as for the proposed facility locations.

#### **3.4.6.3.1 General Site Description**

Aquatic resources on Hanford include the Columbia River, ephemeral streams, springs, surface ponds, and ditches. The Columbia River flows along the northern and eastern edges of the site. The Hanford Reach supports 44 anadromous and resident species of fish. Many of the fish species present in the Hanford Reach are dependent upon flowing water and rocky substrate for at least part of their life cycles. Fall chinook salmon, steelhead trout, mountain whitefish, and smallmouth bass spawn in this area. The destruction of other mainstream Columbia River spawning areas by dams has increased the relative importance of the Hanford Reach for spawning (Neitzel 1999).

The Hanford Reach provides a migration route to upstream spawning areas for spring, summer, and fall adult chinook salmon, coho salmon, sockeye salmon, and steelhead trout. It also provides rearing habitat for the salmonid juveniles in their downstream migration to the sea. Principal resident fish species sought by anglers in the Hanford Reach include mountain whitefish, white sturgeon, smallmouth bass, crappie, catfish, walleye, and yellow perch (Neitzel 1999).

The Yakima River borders the southern portion of Hanford. Game fish found in the river in the vicinity of the site are smallmouth bass, steelhead trout, and channel catfish. Cold Creek and its tributary, Dry Creek, are ephemeral streams within the Yakima River drainage system along the southern boundary of Hanford. These streams do not support any fish populations.

There are several springs at Hanford. Rattlesnake Springs and Snively Springs, which are in the western portion of the site, form short streams that seep into the ground. None of the springs support any fish populations.

#### **3.4.6.3.2 Locations of Proposed Activities**

##### **300 AREA**

The 300 Area is immediately to the west of the Columbia River. There are no aquatic resources on the site itself (Nielsen 2000).

##### **400 AREA**

Although no natural aquatic habitat occurs in the 400 Area, a small cooling and wastewater pond is present (DOE 1999e:3-36). The 400 Area is 6.8 kilometers (4.2 miles) west of the Columbia River.

#### **3.4.6.4 Threatened and Endangered Species**

Endangered species are those plants and animals in danger of extinction throughout all or a large portion of their range. Threatened species are those species likely to become endangered within the foreseeable future. Threatened and endangered species are described for Hanford as a whole, as well as for the proposed facility locations.

##### **3.4.6.4.1 General Site Description**

Eighty-one Federal- and state-listed threatened, endangered, and other special status species may be found on Hanford. These are listed in Tables 4–6 and 4–7 of the *Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 1999k). Nineteen of these are Federal- or state-listed as threatened or endangered, while the remainder are listed by the state within one of several special status classifications.

The threatened bald eagle, which has been proposed to be delisted, is the only federally listed species known to be found regularly at Hanford, although there are occasional sightings of the threatened Aleutian Canada goose. The bald eagle, which is also listed by the state as endangered, is a regular winter resident along the Hanford Reach where it forages for salmon and waterfowl. Trees in the historic Hanford Townsite area are used by eagles for perching. Recently, eagles have attempted to nest on the site. The peregrine falcon, listed as endangered by the state, is a migrant in the Hanford area (Dirkes and Hanf 1997:F.1; DOE 1996b:3-44; Neitzel 1999). The Upper Columbia River run of steelhead and Upper Columbia River spring run of Chinook salmon are listed as endangered and the Middle Columbia River run of steelhead are listed as threatened by the Federal government. Spring-run chinook salmon do not spawn in the Hanford Reach but use it as a

migration corridor. Little is known about the quality and quantity of steelhead spawning, rearing, and adult holding habitat in the Hanford Reach and Upper Columbia River (DOE 1999k). Recently, the Hanford Reach has been designated as critical habitat for Upper Columbia River spring-run chinook salmon and Upper Columbia River steelhead (65 FR 7764). Consultation to comply with Section 7 of the Endangered Species Act was conducted with the U.S. Fish and Wildlife Service and National Marine Fisheries Service. Consultation was also conducted with the state. The results of these consultations are presented in Chapter 4.

The 24 Command Fire burned 24,384 hectares (60,254 acres) of Hanford resulting in potential impacts to a number of threatened, endangered, or other special status species. A total of 9 plant and 12 animal special status species could potentially be found in the burn area (DOI 2000). A post-fire survey determined that suitable habitat for the threatened Ute ladies'-tresses, the only federally listed plant species, did not exist in the burn area. The fire could have directly or indirectly affected seven state-listed plants. Direct effects could include loss of plants and seed stock. Indirect effects could include adverse impacts such as competition from invasive plant species, potential loss of soil productivity due to wind erosion, and loss of seed viability. Indirect effects could also be of a beneficial nature and include release of nutrients back into the soil and reduction in competition for soil nutrients, sun, and soil moisture. With respect to wildlife, the 24 Command Fire was determined to have had no effect on any federally listed species. Potential direct impacts to state-listed species include direct loss of adults and young, while indirect effects include loss of habitat used for feeding, cover, and raising young. Monitoring special status species will be necessary to determine the exact nature and extent to which plants and animals were impacted by the fire.

#### **3.4.6.4.2 Locations of Proposed Activities**

##### **300 AREA**

A survey of the 300 Area made in conjunction with an environmental assessment of RPL did not locate any Federal- or state-listed threatened or endangered plant or animal species within the site (DOE 1997d). However, more recently, the peregrine falcon and bald eagle have been observed in the area (Nielsen 2000).

##### **400 AREA**

No Federal- or state-listed threatened or endangered plants or animals reside in the vicinity of the 400 Area (DOE 1999e), although potential exists for the incidental occurrence of some migratory species, such as the peregrine falcon. State sensitive plant species have not been found in the 400 Area, although Piper's daisy does occur in the vicinity. A fire also burned the area in the mid 1980s, leaving it dominated by cheatgrass and some small shrubs (Mecca 1997b; Schinner 1999).

#### **3.4.7 Cultural and Paleontological Resources**

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. The three general categories of cultural resources addressed in this section are prehistoric, historic, and Native American. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age, and may be sources of information on paleoenvironments and the evolutionary development of plants and animals.

Hanford has a well-documented record of cultural and paleontological resources. The *Hanford Cultural Resources Management Plan* (Battelle 1989), establishes guidance for identifying, evaluating, recording, curating, and managing these resources. There are approximately 930 cultural resource sites and isolated finds recorded (Neitzel 1999:4.104). Forty-eight archaeological sites and one building are included on the National Register of Historic Places. Nominations have been prepared for several archaeological districts and sites

considered to be eligible for listing on the National Register. While many significant cultural resources have been identified, only about 6 percent of the Hanford Site has been surveyed, and few of the known sites have been evaluated for their eligibility for listing on the National Register. Cultural resource reviews are conducted whenever projects are proposed in previously unsurveyed areas. In recent years, reviews have exceeded 500 per year.

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented. The sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites, certain locations were used during both periods.

The 24 Command Fire burned 24,384 hectares (60,254 acres) of Hanford, resulting in potential impacts to cultural resources. A preliminary assessment of possible effects to cultural resources determined that a minimum of 190 previously recorded historic and prehistoric archaeological sites may have been affected (DOI 2000). These sites range from lithic scatters to can scatters, Indian hunting sites to ranch buildings, and spirit quest monuments to gas production wells. The preliminary assessment found that wooden structures (e.g., a corral) were destroyed, but that other surface and subsurface artifacts such as glass and lithic debris were not severely altered by the fire. Post-fire surface visibility has been greatly enhanced, which presents opportunities for archaeologists and historians to refine the boundaries of known sites and locate new sites, but also increases the potential for looting and vandalism.

### **3.4.7.1 Prehistoric Resources**

Prehistoric resources are physical properties that remain from human activities that predate written records.

#### **3.4.7.1.1 General Site Description**

About 365 prehistoric archaeological sites and isolated finds have been recorded on Hanford. Of 48 sites included on the National Register of Historic Places, two are individual sites (Hanford Island Site and Paris Site), and the remainder are located in seven archaeological districts. In addition, four other archaeological districts have been nominated or are planned to be nominated for the National Register. A number of sites have been identified along the Middle Columbia River and in inland areas away from the river, but near other water sources. Some evidence of human occupation has been found in the arid lowlands. Sites include remains of numerous pithouse villages, various types of open campsites, graves along the riverbanks, spirit quest monuments (rock cairns), hunting camps, game drive complexes, quarries in mountains and rocky bluffs, hunting and kill sites in lowland stabilized dunes, and small temporary camps near perennial sources of water away from the river (Neitzel 1999).

More than 10,000 years of prehistoric human activity in the largely arid environment of the Middle Columbia River region have left extensive archaeological deposits. Archaeological surveys have been conducted at Hanford since 1926; however, little excavation has been conducted at any of the sites. Surveys have included studies of Gable Mountain, Gable Butte, Snively Canyon, Rattlesnake Mountain, Rattlesnake Springs, and a portion of the Basalt Waste Isolation Project Reference Repository location. Most of the surveys have focused on islands and on a 400-meter (1,312-foot) wide area on either side of the river. From 1991 through 1993, the 100 Areas were surveyed, and new sites were identified. Excavations have been conducted at several sites on the riverbanks and islands and at two unnamed sites. Test excavations have been conducted at the Wahluke, Vernita Bridge, and Tsulim sites and at other sites in Benton County (Neitzel 1999).

### 3.4.7.1.2 Locations of Proposed Activities

#### 300 AREA

Much of the 300 Area has been highly disturbed by industrial activities and is unlikely to contain intact prehistoric sites (Neitzel 1999). The *Hanford Cultural Resources Management Plan* (Battelle 1989) provides for survey work before construction, and has contingency guidelines for handling the discovery of previously unknown archaeological resources encountered during construction.

#### 400 AREA

Most of the 400 Area has been highly disturbed and is unlikely to contain intact prehistoric sites. A cultural resources survey found only 12 hectares (30 acres) that were undisturbed, and no sites were identified either within the 400 Area or within 2 kilometers (1.2 miles) of the 400 Area. The *Hanford Cultural Resources Management Plan* (Battelle 1989) provides for survey work before construction, and has contingency guidelines for handling the discovery of previously unknown archaeological resources encountered during construction.

### 3.4.7.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

#### 3.4.7.2.1 General Site Description

Five hundred seventeen historic archaeologic sites associated with the pre-Hanford Site and the Cold War eras, including an assortment of farmstead, corrals, dumps, and military sites, have been recorded since 1977 (Neitzel 1999). Of these sites, one is included on the National Register of Historic Places as a historic site, and 56 are listed as archaeological sites. Sites and localities that predate the Hanford era include homesteads, ranches, trash scatters, dumps, gold mine tailings, roads, and townsites, including the Hanford townsite and the East White Bluffs townsite and ferry landing. More recent historic structures include the defense reactors and associated materials-processing facilities that played an important role in the Manhattan Project and the Cold War era. A Programmatic Agreement for the maintenance, deactivation, alteration, and demolition of the built environment on Hanford has been reached between DOE, the Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office (DOE 1996d).

Lewis and Clark were some of the first European Americans to visit the Hanford region during their 1804 to 1806 expedition. They were followed by fur trappers, military units, and miners. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach, and Chinese gold miners began to work the gravel bars. Cattle ranches opened in the 1880s, and farmers soon followed. Several small thriving towns, including Hanford, White Bluffs, and Ringold, grew up along the riverbanks in the early 20th century. Other ferries were established at Wahluke and Richland. These towns, and nearly all other structures, were razed after the U.S. Government acquired the land for the original Hanford Engineer Works in the early 1940s (part of the Manhattan Project). Plutonium produced at the 100 B-Reactor was used in the first nuclear explosion at the White Sands Missile Range in New Mexico, and later in the bomb that destroyed Nagasaki, Japan, to help end World War II. The Hanford 100 B-Reactor is listed on the National Register and is designated a National Mechanical Engineering Landmark, a National Historic Civil Engineering Landmark, and a National Nuclear Engineering Landmark. Consultation to comply with Section 106 of the National Historic Preservation Act was conducted with the State Historic Preservation Office. The results of this consultation are presented in Chapter 4.

### 3.4.7.2.2 Locations of Proposed Activities

#### 300 AREA

The 300 Area has been highly disturbed by industrial activities. Five recorded archaeological sites, including campsites, housepits, and historic trash scatter, are located at least partially within the 300 Area; many more may be located in subsurface deposits. Twenty-seven archaeological sites and 13 isolated artifacts have been recorded within 2 kilometers (1.2 miles) of the site. The historic archaeological sites contain debris scatters and roadbeds associated with farmsteads. One site has been tested and is recognized as eligible for listing on the National Register of Historic Places. One hundred fifty-eight buildings or structures in the 300 Area have been inventoried and of that number, 47 have been determined eligible for the National Register as contributing properties within the Historic District recommended for mitigation, including RPL/306-E (DOE 1996d; Neitzel 1999).

#### 400 AREA

Most of the 400 Area has been so disrupted by construction activities, that a 1978 archaeological survey found only 12 hectares (30 acres) that were undisturbed. No cultural resources were located in those 12 hectares (30 acres). No archaeological sites are known to be located within 2 kilometers (1.2 miles) of the 400 Area.

All of the building and structures in the 400 Area were constructed during the Cold War era. Six buildings/structures have been determined eligible for the National Register of Historic Places as contributing properties within the Historic District recommended for mitigation. These include the 405 Reactor Containment Building, 436 Training Facility, 4621-W Auxiliary Equipment Facility, 4703 Fast Flux Test Facility Control Building, 4710 Operation Support Building, and the 4790 Patrol Headquarters (DOE 1996d).

### 3.4.7.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land use conflicts.

#### 3.4.7.3.1 General Site Description

In prehistoric and early historic times, Native Americans of various tribal affiliations heavily populated the Hanford Reach. The Wanapum and the Chamnapum lived along the Columbia River at what is now Hanford. Some of their descendants still live nearby at Priest Rapids, northwest of Hanford. Palus People, who lived on the lower Snake River, joined the Wanapum and Chamnapum to fish the Hanford Reach, and some inhabited the east bank of the river. Walla Walla and Umatilla People also make periodic visits to fish in the area. These people retain traditional secular and religious ties to the region, and many have knowledge of the ceremonies and lifeways of their culture. The Washani, or Seven Drums religion, which has ancient roots and originated among the Wanapum, is still practiced by many people on the Yakama, Umatilla, Warm Springs, and Nez Perce Reservations. Native plant and animal foods, some of which can be found at Hanford, are used in the ceremonies performed by tribal members.

Consultation is required, and was conducted, to identify the traditional cultural properties that are important in maintaining the cultural heritage of Native American tribes. The results of this consultation are presented in Chapter 4. Under separate treaties signed in 1855, the Confederated Tribes and Bands of the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation ceded lands to the United States that

include the present Hanford Site. Under the treaties, the tribes reserved the right to fish at usual and accustomed places in common with the citizens of the territory, and retained the privilege of hunting, gathering roots and berries, and pasturing horses and cattle upon open, unclaimed land. The Treaty of 1855 with the Nez Perce Tribe includes similar reservations of rights, and the Nez Perce have identified the Hanford Reach as the location of usual and accustomed places for fishing. The Wanapum People are not signatory to any treaty with the United States and are not a federally recognized tribe; however, they live about 8 kilometers (5 miles) west of the Hanford boundary, they were historical residents of Hanford, and their interests in the area have been acknowledged.

All of these tribes are active participants in decisions regarding Hanford and have expressed concerns about hunting, fishing, pasture rights, and access to plant and animal communities and important sites. Sites sacred to Native Americans at Hanford include remains of prehistoric villages, burial grounds, ceremonial longhouses or lodges, rock art, fishing stations, and vision quest sites. Culturally important localities and geographic features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, Coyote Rapids, and the White Bluffs portion of the Columbia River.

#### **3.4.7.3.2 Locations of Proposed Activities**

##### **300 AREA**

One documented locality with great importance to the historic Wanapum is near the 300 Area. Certain areas near the 300 Area have been found to be of great importance to Native Americans and are fenced (Neitzel 1999).

##### **400 AREA**

The 400 Area is not known to contain any Native American resources.

#### **3.4.7.4 Paleontological Resources**

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

##### **3.4.7.4.1 General Site Description**

Remains from the Pliocene and Pleistocene Ages have been identified at Hanford. The Upper Ringold Formation dates to the Late Pliocene Age and contains fish, reptile, amphibian, and mammal fossil remains. Late Pleistocene Touchet beds have yielded mammoth bones. These beds are composed of fluvial sediments deposited along ridge slopes that surround Hanford.

##### **3.4.7.4.2 Locations of Proposed Activities**

##### **300 AREA**

Paleontological resources are limited in the vicinity of the 300 Area, and no such resources have been located within the site itself (Nielsen 2000).

## 400 AREA

No paleontological resources have been reported in the 400 Area. Late Pleistocene Touchet beds, which have yielded mammoth bones, are located at distances greater than 5 kilometers (3.1 miles) from the 400 Area.

### 3.4.8 Socioeconomics

Statistics for employment and regional economy are presented for the regional economic area, as defined in Appendix G.8, which encompasses nine counties surrounding Hanford in Washington. Statistics for population, housing, community services, and local transportation are presented for the region of influence, a two-county area in which 91 percent of all Hanford employees reside (**Table 3–30**). In 1997, Hanford employed 12,882 persons, 3.8 percent of the regional economic area civilian labor force (DOE 1999e).

**Table 3–30 Distribution of Employees by Place of Residence  
in the Hanford Region of Influence, 1997**

County	Number of Employees	Total Site Employment (percent)
Benton	10,563	82.0
Franklin	1,159	9.0
Region of influence total	11,722	91.0

Source: DOE 1999e.

#### 3.4.8.1 Regional Economic Characteristics

Between 1990 and 1996, the civilian labor force in the regional economic area increased 34.6 percent, to the 1996 level of 342,941. In 1996, the annual unemployment average in the regional economic area was 11.1 percent, significantly higher than the annual unemployment average of 6.5 percent in Washington State (DOE 1999e).

In 1995, service activities represented the largest sector of employment in the regional economic area (22.3 percent). This was followed by agriculture (19.6 percent) and government (17.4 percent). Overall, the state total for these employment sectors was 25.0 percent, 3.7 percent, and 18.0 percent, respectively (DOE 1999e).

#### 3.4.8.2 Population and Housing

In 1996, the region of influence population totaled 179,949. Between 1990 and 1996, the region of influence population increased 18.9 percent, compared with the 12.9 percent increase experienced in Washington. Between 1980 and 1990, the number of housing units in the region of influence increased by 4.6 percent, compared with a 20.3 percent increase in Washington. The 1990 homeowner vacancy rates for the region of influence was 1.4 percent, compared with the state's rate of 1.3 percent. The region of influence renter vacancy rate was 5.5 percent, compared with 5.8 percent for the state (DOE 1999e).

#### 3.4.8.3 Community Services

##### 3.4.8.3.1 Education

In 1997, ten school districts providing public education in the Hanford region of influence were operating at capacities ranging from 65 to 100 percent. Total student enrollment in the region of influence in 1997 was 38,206 and the student-to-teacher ratio in the region of influence averaged 16:1. In 1990, the average student-to-teacher ratio for Washington was 11.4:1 (DOE 1999e).

#### **3.4.8.3.2 Public Safety**

In 1997, a total of 281 sworn police officers were serving the region of influence. The region of influence average officer-to-population ratio was 1.6 officers per 1,000 persons. This compares with the 1990 state average of 1.7 police officers per 1,000 persons. In 1997, 616 paid and volunteer firefighters provided fire protection services in the Hanford region of influence. The average firefighter-to-population ratio in 1997 in the region of influence was 3.4 firefighters per 1,000 persons. This compares with the 1990 state average of 1 firefighter per 1,000 persons (DOE 1999e).

#### **3.4.8.3.3 Health Care**

In 1996, a total of 257 physicians served the region of influence. The average physician-to-population ratio in the region of influence was 1.4 physicians per 1,000 persons compared with the 1996 state average of 3.7 per 1,000 persons. In 1997, there were four hospitals serving the region of influence. The hospital bed-to-population ratio averaged 2.1 beds per 1,000 persons. This compares with a state 1991 average of 2.4 beds per 1,000 persons (DOE 1999e).

#### **3.4.8.4 Local Transportation**

Vehicle access to Hanford is provided by State Routes 240, 243, and 24. State Route 240 connects to the Richland bypass highway, which interconnects with I-182. State Route 243 exits the site's northwestern boundary and serves as a primary link between the site and I-90. State Route 24 enters the site from the west and continues eastward across the northernmost portion of the site and intersects State Route 26 about 16 kilometers (10 miles) east of the site boundary (Figure 3-12) (DOE 1999e). Only routine preservation projects are planned by the Washington State Department of Transportation for the state routes listed above and are not considered to impact access into the site (Trepanier 2000).

The local intercity transit system, Ben Franklin Transit, supplies bus service between the Tri-Cities and Hanford, although bus service is provided only to the 300 Area and Energy Northwest. Both private interests and Ben Franklin Transit provide van pooling opportunities in the region of influence.

There is presently no rail service at Hanford, except for a spur to Energy Northwest. Onsite rail transport was formerly provided by a short-line railroad that connected with the Union Pacific line just south of the Yakima River. The Union Pacific line interchanges with the Burlington Northern-Santa Fe at the city of Kennewick. The Hanford railroad is still intact and service could be restored if needed.

In the region of influence, the Columbia River is used as an inland waterway for barge transportation from the Pacific Ocean. The Port of Benton provides a barge slip where shipments arriving at Hanford may be off-loaded.

Tri-Cities Airport, near the city of Pasco, provides jet air passenger and cargo service by both national and local carriers. Numerous smaller private airports are located throughout the region of influence (DOE 1999e).

#### **3.4.9 Existing Human Health Risk**

Existing human health risk issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

### 3.4.9.1 Radiation Exposure and Risk

#### 3.4.9.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of Hanford are shown in **Table 3–31**. Annual background radiation doses to individuals are expected to remain constant over time.

**Table 3–31 Sources of Radiation Exposure to Individuals in the Hanford Vicinity  
Unrelated to Hanford Operations**

Source	Effective Dose Equivalent (millirem per year)
<b>Natural background radiation<sup>a</sup></b>	
Cosmic radiation	30
External terrestrial radiation	30
Internal radiation	40
Radon in homes (inhaled)	200
<b>Other background radiation<sup>b</sup></b>	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	Less than 1
Air travel	1
Consumer and industrial products	10
<b>Total</b>	<b>365</b>

a. Dirkes, Hanf, and Poston 1999.

b. NCRP 1987:11, 40, 53.

**Note:** Value of radon is an average for the United States.

The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses, as identified in Table 3–31, are unrelated to Hanford operations.

Releases of radionuclides to the environment from Hanford operations provide another source of radiation exposure to individuals in the vicinity of Hanford. Types and quantities of radionuclides released from Hanford operations in 1998 are listed in the *Hanford Site Environmental Report for Calendar Year 1998* (Dirkes, Hanf, and Poston 1999:5.5–5.10). Doses to the public resulting from these releases are presented in **Table 3–32**. These doses fall within radiological limits per DOE Order 5400.5 and are much lower than those of background radiation.

Using a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Appendix H), the risk of a latent cancer fatality to the maximally exposed member of the public due to radiological releases from Hanford operations in 1998 is estimated to be  $1.1 \times 10^{-8}$ . That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Hanford operations is approximately 1 in 100 million. It takes several to many years from the time of radiation exposure for a cancer to manifest itself.

According to the same risk estimator,  $1 \times 10^{-4}$  excess latent cancer fatality are projected in the population of 370,000 living within 80 kilometers (50 miles) of Hanford from normal operations in 1998. To place this number in perspective, it may be compared with the number of cancer fatalities expected in the same population from all causes. The 1997 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year. Based on this mortality rate, the number of cancer fatalities expected during 1998 from all causes in the population living within 80 kilometers (50 miles) of Hanford was 740. This expected number of cancer fatalities (which excludes any radiation dose contribution from Hanford) is much higher than the  $1 \times 10^{-4}$  latent cancer fatality estimated from Hanford operations in 1998.

**Table 3–32 Radiation Doses to the Public from Hanford Normal Operations in 1998  
(Total Effective Dose Equivalent)**

Members of the Public	Atmospheric Releases <sup>a</sup>		Liquid Releases		Total	
	Standard <sup>b</sup>	Actual	Standard <sup>b</sup>	Actual	Standard <sup>b</sup>	Actual
Maximally exposed individual (millirem)	10	0.015	4	0.0077 <sup>c</sup>	100	0.022
Population within 80 kilometers (person-rem) <sup>d</sup>	None	0.084	None	0.11	100	0.19
Average individual within 80 kilometers (millirem) <sup>e</sup>	None	3.4×10 <sup>-4</sup>	None	2.9×10 <sup>-4</sup>	None	5.0×10 <sup>-4</sup>

a. Includes direct radiation dose from surface deposits of radioactive material.

b. The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10-millirem-per-year limit from airborne emissions is required by the Clean Air Act, and the 4-millirem-per-year limit is required by the Safe Drinking Water Act; for this NI PEIS, the 4-millirem-per-year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100-millirem-per-year is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR Part 834, as published in 58 FR 16268. If the potential total dose exceeds the 100-person-rem value, it is required that the contractor operating the facility notify DOE.

c. Includes the drinking water dose.

d. Based on a population of about 380,000 in 1998.

e. Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site.

**Source:** Dirkes, Hanf, and Poston 1999:5.9, 5.10.

Hanford workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. The average dose to the individual worker and the cumulative dose to all workers at Hanford from operations in 1998 are presented in **Table 3–33**. These doses fall within the radiological regulatory limits of 10 CFR Part 835. According to a risk estimator of 400 cancer fatalities per 1 million person-rem among workers<sup>1</sup> (Appendix H), the number of projected latent cancer fatalities among Hanford workers from normal operations in 1998 is 0.072.

**Table 3–33 Radiation Doses to Workers from Hanford Normal Operations in 1998  
(Total Effective Dose Equivalent)**

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard <sup>a</sup>	Actual
Average radiation worker (millirem)	None <sup>b</sup>	102
Total workers <sup>c</sup> (person-rem)	None	181

a. The radiological limit for an individual worker is 5,000 millirem per year. However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established the Administrative Control Level of 2,000 millirem per year; the site must make reasonable attempts to maintain individual worker doses below this level.

b. No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

c. 1,772 with measurable doses in 1998.

**Source:** 10 CFR Section 835.202; DOE 1999p.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Hanford Site Environmental Report for Calendar Year 1998* (Dirkes, Hanf, and Poston 1999). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off site) are also presented in that report.

<sup>1</sup> The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

### 3.4.9.1.2 Locations of Proposed Activities

#### 300 AREA

External radiation doses have been measured in the 300 Area. In 1998, the annual dose in the 300 Area was about 83 millirem. This is about 5 to 12 millirem higher than the value measured at the off site control locations. This onsite dose affects workers only, and is well below limits identified in Table 3–33. No measurements of plutonium concentrations in air were reported for the 300 Area (Dirkes, Hanf, and Poston 1999:4.84, 4.85).

#### 400 AREA

External radiation doses have been measured in the 400 Area. In 1998, the annual dose in the 400 Area was about 83 millirem. This is about 5 to 12 millirem higher than the value measured at the offsite control locations. This onsite dose affects workers only, and is well below limits identified in Table 3–33. No measurements of plutonium concentrations in air were reported for the 400 Area (Dirkes, Hanf, and Poston 1999:4.84, 4.85).

### 3.4.9.2 Chemical Environment

The background chemical environment important to human health consists of the atmosphere which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects.

**Carcinogenic Effects.** Health effects in this case are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogenic. This could be incremental or excess individual lifetime cancer risk.

**Noncarcinogenic Effects.** Health effects in this case are determined by the ratio between the calculated or measured concentration of the chemical in the air and the reference concentration or dose. This ratio is known as the Hazard Quotient. Hazard Quotients for noncarcinogens are summed to obtain the Hazard Index. If the Hazard Index is less than 1, no adverse health effects would be expected.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur by inhaling air containing hazardous chemicals released to the atmosphere during normal Hanford operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.4.3. The baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations.

Exposure pathways to Hanford workers during normal operations may include inhaling contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies

among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm.

### **3.4.9.3 Health Effects Studies**

The question of whether or not the population surrounding Hanford is subject to elevated rates of cancer incidence or cancer mortality is unresolved. Existing studies and data suggest that cancer mortality rates among populations residing near Hanford are not elevated. A survey sponsored by the National Cancer Institute and published in the *Journal of the American Medical Association* in 1991 (Jablon, Hrubec, and Boice 1991:1403–1408) detected no general increase in the risk of cancer death for people living in 107 counties adjacent to or containing 62 nuclear facilities. Hanford, INEEL, and ORR were included in the survey. The study used cancer mortality data from Benton, Franklin, and Grant counties in the survey for Hanford. The methodology used in the survey did not attempt to estimate actual exposures to ionizing radiation or hazardous chemicals and did not allow identification of areas within a given county that might have increased or decreased cancer rates relative to the country as a whole. The authors of the study concluded that if any excess cancer mortality risk were present in U.S. counties with nuclear facilities, it was too small to be detected with the methods employed.

Sixteen counties are within 80 kilometers (50 miles) of the Hanford boundary—13 counties in Washington and 3 in Oregon. Prevailing winds at Hanford blow toward Grant County, Washington, from the south (14 percent of the time) and south-southwest (11.5 percent of the time). Therefore, Grant County would be expected to bear the major burden of wind-borne contamination from Hanford. Cancer mortality data published by the National Cancer Institute ([www.nci.nih.gov/atlas](http://www.nci.nih.gov/atlas)) for white female and white male residents for all U.S. counties from 1970 to 1994 show no elevated cancer rates for white residents of Grant County. Cancer mortality rates among white females in the 16 counties ranged from a low of 80.1 per 100,000 person-years in Gilliam County, Oregon, to a high of 149.5 per 100,000 person-years in Lincoln County, Washington. Adams, Klickitat, and Lincoln counties were found to have cancer mortality rates among white females above the National cancer mortality rate for white females of 135.9 per 100,000 person-years. The remaining 13 counties have cancer mortality rate for white females below the National cancer mortality rate for white females. Cancer mortality rates among white males in the 16 counties range from a low of 161.9 per 100,000 person-years in Gilliam County, Oregon, to a high of 211.8 per 100,000 person-years in Morrow County, Oregon. Morrow County was found to have a cancer mortality rate among white males above the National cancer mortality rate for white males of 209.5 per 100,000 person-years. The remaining 15 counties were found to have cancer mortality rates below the National cancer mortality rate for white males. The data does not include estimates of human exposures to ionizing radiation or hazardous chemicals.

Two studies of birth defects in Benton and Franklin counties were published in 1988 (Sever et al. 1988a:226–241; 1988b:243–254). The studies focused on congenital malformations among infants born from 1968 to 1980. The studies showed a statistically significant association between parental preconception exposure to ionizing radiation and neural tube defects in their infants. Other defects in the infant studies showed no statistically significant association with parental radiation exposure.

Many epidemiological studies have been carried out on the Hanford workers over the years. The studies have consistently shown a statistically significant elevated risk of death from multiple myeloma associated with

radiation exposure among Hanford male workers. The elevated risk was observed only among workers exposed to 10 rads (approximately 10 rem) or more. Other studies have also identified an elevated risk of death from pancreatic cancers, but a recent reanalysis did not conclude there was an elevated risk. Studies of female Hanford workers have shown an elevated risk of deaths from musculoskeletal system and connective tissue conditions. For a more detailed description of the studies reviewed and their findings, and for a discussion of the epidemiologic surveillance program implemented by DOE to monitor the health of current workers, refer to Appendix M.4.2 of the *Storage and Disposition PEIS* (DOE 1996b:M-224–M-230).

#### 3.4.9.4 Accident History

DOE maintains a safe and healthy workplace in accordance with DOE P 450.4, *Safety Management Systems Policy*; DOE Order 420.1, *Facility Safety*; DOE Order 151.1A, *Comprehensive Emergency Management System*; 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*; 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*; and the Washington Administrative Code 267-247. There are three tiers of safety organizations at Hanford: the DOE Operations Office, Fluor Hanford, and project-specific organizations. Each safety organization is responsible for protection of the public, workers, and the environment. Information concerning safety-related events at Hanford and other sites is available from the DOE occurrence reporting system on the Internet at [tis.eh.doe.gov/oeaf/orps.html](http://tis.eh.doe.gov/oeaf/orps.html).

Hanford implements corrective actions for all safety-related incidents. For example, although unrelated to candidate facilities discussed in this NI PEIS, a chemical explosion occurred at the Hanford Plutonium Reclamation Plant in a room where nonradioactive bulk chemicals were mixed for the now-discontinued plutonium recovery process. The direct cause of the accident was the concentration by evaporation of the dilute solution in a tank to the point where a spontaneous reaction occurred, creating a rapid gas evolution that over-pressurized the tank beyond its physical design limitations. No one was injured and no radioactive materials were released to the environment (DOE 1997h). Eight workers outside the plant at the time of the explosion complained of symptoms that included headaches, dizziness, and an unidentified metallic taste. All eight workers were transferred to a nearby medical center where they were examined and released. The explosion caused significant localized damage to the facility. Corrective actions focused on improving shutdown planning to maintain the facility in a safe condition, consistent with the approved safety authorization documentation, and improving emergency preparedness and response. As discussed in Section 3.4.9.5, lessons learned from this event were implemented across the DOE complex to improve emergency preparedness and response.

There have been no nuclear-related accidents or accidental releases of hazardous or radioactive materials causing injury or harm to workers, or posing any threat to the offsite public at FFTF or at the candidate Hanford support facilities evaluated in this NI PEIS. Examples of the most severe safety incidents that have occurred at these facilities are discussed below. In all cases, corrective actions were completed to address the cause of each event, and there were no long-term programmatic consequences:

- A loss of contamination control event occurred in February 1990 at a maintenance facility adjacent to FFTF during a filter replacement on the bottom-loading transfer cask (an FFTF fuel-handling machine) resulting in contamination spread to the adjacent area within the facility. The contamination was successfully cleaned up and the facility was restored to normal access and work control. Corrective actions to prevent similar occurrences included (1) training program changes and additional training of plant personnel on job controls and planning for these types of hazards, (2) strengthened requirements for pre-job briefings and Person-in-Charge responsibilities, and (3) more detailed requirements for the various types of radiological control areas.

- A sodium pump developed a leak in 1984. As a result of the leak, 75 gallons of sodium spilled in a closed room filled with inert gas. It was determined that the hole was created by two conditions: tube wall thinning due to cavitation and rapid heatup during a previous meltout. Enhanced leak detection was installed on all normally inaccessible pumps, and a visual inspection was conducted on the remaining pumps. Procedural flow restrictions were placed on the pumps to preclude any additional cavitation conditions, and changes were made to the meltout procedures to reduce the allowable heatup rate. The sodium was removed and the pump was replaced with a spare.
- Two unplanned tritium releases occurred at RPL in 1998 because of equipment failure or operator error. These releases were within the levels specified by the facility's air operating permit and did not result in the exposure of site personnel or members of the public in excess of regulatory standards. Corrective actions included the redesign of a sampling system to permit more effective leak testing, and implementation of administrative controls to eliminate operator error.

#### **3.4.9.5 Emergency Preparedness**

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

Accordingly, the DOE Richland Operations Office has developed and maintains a comprehensive set of emergency preparedness plans and procedures for Hanford to support onsite and offsite emergency management actions in the event of an accident. The DOE Richland Operations Office also provides technical assistance to other Federal agencies and to state and local governments. Hanford contractors are responsible for ensuring that emergency plans and procedures are prepared and maintained for all facilities, operations, and activities under their jurisdiction, and for directing implementation of those plans and procedures during emergency conditions. The DOE Richland Operations Office, contractor, and state and local government plans are fully coordinated and integrated. Emergency control centers have been established by the DOE Richland Operations Office and its contractors for the principal work areas to provide oversight and support to emergency response actions within those areas.

Following the May 1997 explosion at Hanford discussed in Section 3.4.9.4, a review of the emergency management response indicated that multiple programs and systems failed in the hours following the accident. In a letter to Secretarial Offices, Secretary of Energy Federico Peña identified actions to be taken at all DOE sites for implementing lessons learned from the emergency response. The actions involve the following elements:

- Improve training for facility and site emergency personnel
- Ensure that equipment and qualified personnel are ready for the wide variety of potential radiological and chemical hazards
- Improve coordination with local medical communities
- Have in place comprehensive procedures to attend to personnel who are potentially affected by an accident

#### **3.4.10 Environmental Justice**

Under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, Federal agencies are responsible for identifying and addressing the possibility of disproportionately high and adverse health, economic, and environmental impacts of programs and activities

on minority and low-income populations in potentially affected areas. Minority populations refer to persons of any race self-designated as Asian, Black, Native American, or Hispanic. Low-income populations refer to households with incomes below the Federal poverty thresholds. In the case of Hanford, the potentially affected area includes parts of Washington and Oregon.

The potentially affected area surrounding the 400 Area is defined by a circle with an 80-kilometer (50-mile) radius centered at FMEF (latitude 46° 26'7" N, longitude 119° 21'55" W). The total population residing within that area in 1990 was 277,515; minorities made up 25.4 percent of the total population (DOE 1999e). In 1990, approximately one-fourth of the total national population was comprised of persons self-designated as members of a minority group, and minorities made up 13.2 percent of Washington State's total population and 9.2 percent of Oregon's total population.

According to the 1990 census, the racial and ethnic composition of the minority population in the potentially affected area around FMEF are as follows: Hispanics were the largest minority group, constituting 21.5 percent of the total population; Asians comprised 1.4 percent of the total population, Native Americans 1.4 percent, and Blacks 1.0 percent (DOE 1999e).

In 1990, the poverty threshold was \$9,981 for a family of three with one related child under 18 years of age. A total of 45,820 persons, 17.3 percent of the total population, residing within the potentially affected area around the 400 Area reported incomes below the poverty threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, corresponding percentages for Washington and Oregon were 10.9 and 12.4 percent, respectively.

### 3.4.11 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and state statutes and DOE orders.

#### 3.4.11.1 Waste Inventories and Activities

Hanford manages the following types of waste: high-level, transuranic, mixed transuranic, low-level radioactive, mixed low-level radioactive, hazardous, and nonhazardous. Waste generation rates and the inventory of stored waste from activities at Hanford are provided in **Table 3–34**. Waste generation rates specifically for FFTF in standby and RPL/306–E activities are provided in **Table 3–35**. The Hanford waste management capabilities are summarized in **Table 3–36**. More detailed descriptions of the waste management system capabilities at Hanford are included in the *Storage and Disposition PEIS* (DOE 1996b:3-61, E-12).

EPA placed Hanford on the National Priorities List on November 3, 1989. In accordance with CERCLA, DOE entered into a Tri-Party Agreement with EPA and the Washington State Department of Ecology to govern the environmental compliance and cleanup of Hanford. This agreement meets the legal requirements specified under the Federal Facility Compliance Act. An aggressive environmental restoration program is under way using priorities established in the Tri-Party Agreement (DOE 1996b:3-61). More information on regulatory requirements for waste disposal is provided in Chapter 5.

**Table 3–34 Waste Generation Rates and Inventories at Hanford**

Waste Type	Generation Rate (cubic meters per year)	Inventory (cubic meters)
<b>High-level radioactive</b>	0	213,000
<b>Transuranic and mixed transuranic</b>		
Contact handled	450	11,450
Remotely handled	72	273
<b>Low-level radioactive</b>	3,902 <sup>a</sup>	0
<b>Mixed low-level radioactive</b>		
RCRA	840	8,170
TSCA	7	103
<b>Hazardous</b>	560	NA <sup>b</sup>
<b>Nonhazardous</b>		
Liquid	200,000	NA <sup>b</sup>
Solid	43,000	NA <sup>b</sup>

a. Excludes waste from DOE environmental restoration activities.

b. Generally, hazardous and nonhazardous wastes are not held in long-term storage.

**Note:** To convert from cubic meters to cubic yards, multiply by 1.308.

**Key:** NA, not applicable; RCRA, Resource Conservation and Recovery Act; TSCA, Toxic Substances Control Act.

**Source:** LMER 1996e:15, 16, except high-level radioactive waste (DOE 1997a), hazardous and nonhazardous solid wastes (DOE 1996b:3-62, E-19), and nonhazardous liquid wastes (Teal 1997).

**Table 3–35 Waste Generation Rates at FFTF and RPL/306–E**

Waste Type	FFTF (cubic meters per year)	RPL/306–E (cubic meters per year)
<b>High-level radioactive</b>	0	0
<b>Transuranic</b>	0	8
<b>Low-level radioactive</b>		
Liquid	<6	104 <sup>a</sup>
Solid	17	-
<b>Mixed low-level radioactive</b>	<0.5	15
<b>Hazardous</b>	4 <sup>b</sup>	6
<b>Nonhazardous</b>		
Process wastewater	76,000	28,400
Sanitary wastewater	3,800	4,970
Solid	120	4

a. Represents both liquid and solid low-level radioactive waste.

b. Represents both liquid and solid hazardous waste.

**Note:** To convert from cubic meters to cubic yards, multiply by 1.308.

**Source:** DOE 2000c, Tenforde 2000.

**Table 3–36 Waste Management Capabilities at Hanford**

Facility Name/ Description	Capacity	Status	HLW	Applicable Waste Type					
				TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment Facility (cubic meters per year except as otherwise specified)									
242-A Evaporator, cubic meters per day	265	Online	X	X	X	X	X		
Waste Receiving and Processing Facility <sup>a</sup>	1,820	Online		X	X	X	X		
M91 Facility	Will be negotiated	Will be negotiated		X	X	X	X		
Shielded Analytical Lab Waste Treatment Unit, kilograms per hour	4	Online					X		
Maintenance & Storage Facility, batch per year	26	Online					X		
200 Area Liquid Effluent Treatment Facility, cubic meters per minute	0.57	Online				X	X		
200 East Area Sanitary Wastewater Treatment Facility	120,000	Online							X
Storage Facility (cubic meters)									
Tank Farms	146,000	Online	X	X	X	X			
Central Waste Complex	16,800	Online		X	X	X	X		
Transuranic Waste Storage and Assay Facility	416	Standby		X	X	X	X		
305-B Storage Facility	20	Online				X	X	X	
B-Plant Canyon Waste Pile	5	Online				X			
B-Plant Container Storage	51	Online					X		
PUREX Tunnel 1	4,141	Online				X	X		
PUREX Tunnel 2	19,528	Online				X	X		
PUREX Canyon Waste Pile	432	Online					X		
200 Area Liquid Effluent Rentention Facility	59,000	Online				X	X		
4843 Alkali Metal Storage Facility	95	Standby					X	X	
Disposal Facility (cubic meters except as otherwise specified)									
Grout Vault	230,000	Online				X			
Low-Level Radioactive Waste Burial Ground	1,740,000	Online				X			
Radioactive Mixed Waste Disposal Facility	14,200	Standby				X	X		
200 Area Treated Effluent Disposal Facility, cubic meters per minute	8.7	Online							X
Energy Northwest Sewage Treatment Facility, cubic meters per year	235,000	Online							X

a. The facility is used primarily for certification and repackaging transuranic wastes for shipment to WIPP and is also used to verify small quantities of low-level radioactive and mixed low-level radioactive wastes.

**Note:** To convert from cubic meters to cubic yards, multiply by 1.308.

**Key:** Haz, hazardous; HLW, high-level radioactive waste; LLW, low-level radioactive waste; PUREX, Plutonium-Uranium Extraction (Plant); TRU, transuranic radioactive waste; WIPP, Waste Isolation Pilot Plant.

**Source:** DOE 1996b:E-15; 1999e:3-10; Teal 1997.

#### **3.4.11.2 High-Level Radioactive Waste**

High-level radioactive waste was generated in the recovery of uranium and plutonium from spent fuel generated in the production reactors. All of this radioactive waste is considered mixed waste because of its toxic and hazardous constituents as defined by RCRA. It must be remotely handled because of its high radiation levels. The waste was generated as liquids and sludges and stored in underground tanks where the sludges and salts in the liquid have precipitated out of solution as porous solids (called salt cake) and settled to the bottom of the tanks. The liquid above the solids has been pumped from the older, single-shelled tanks into newer, double-shelled tanks. The liquids that remain in the porous salt cake will be removed by boring holes through the salt cake and extracting liquids from near the tank bottoms. The wastes are segregated and handled according to their hazardous nature (corrosivity, chemical stability, heat generation rates), and require special monitoring and venting. Cooling is needed for some of these wastes. The wastes are concentrated by evaporation and returned to the tanks for storage until final processing to a form suitable for disposal in a geologic repository. It is planned to vitrify high-level radioactive waste water-soluble sludges and selected radionuclides separated from liquids retrieved from the tanks. In addition to this liquid and solid high-level radioactive waste, an inventory of encapsulated cesium and strontium is stored in the Waste Encapsulation and Storage Facility in a water-cooled pool. Some of this material was used as irradiation sources in, for example, radiography and food irradiation (DOE 1996:3-65).

#### **3.4.11.3 Transuranic and Mixed Transuranic Waste**

All generated contact-handled transuranic waste is being placed in above-grade storage buildings at the Hanford Central Waste Complex (DOE 1996b:3-64). Transuranic waste will be maintained in storage until it is shipped to WIPP in Carlsbad, New Mexico, for disposal, or to a suitable geologic repository. The new Waste Receiving and Processing Facility has the capability to certify drummed or small container transuranic waste for shipment to WIPP (Dirkes and Hanf 1996:10). Transuranic wastes to be transported to WIPP will be packaged and shipped to WIPP for disposal in accordance with DOE and DOT requirements and WIPP waste acceptance criteria. Mixed transuranic wastes are included in the transuranic waste category because these wastes are expected to go to WIPP for ultimate disposal (DOE 1996b:3-64). The first shipment of transuranic waste from Hanford was received at WIPP on July 14, 2000 (DOE 2000d:2).

#### **3.4.11.4 Low-Level Radioactive Waste**

Solid low-level radioactive waste is compacted and sent to the Low-level Radioactive Waste Burial Ground in the 200 West Area for disposal in trenches. Additional low-level radioactive waste is received from offsite generators and disposed of at the Low-level Radioactive Waste Burial Ground. Low-level radioactive waste resulting from the River Protection Project-tank waste treatment will be vitrified. The vitrified low-level radioactive waste will be disposed of on site in the 200 Area as part of the tank waste remediation system program (DOE 1996b:3-64). Low-level radioactive waste resulting from CERCLA cleanup activities are disposed of on site at the Environmental Restoration Disposal Facility.

U.S. Ecology operates a licensed commercial low-level radioactive waste Burial Ground on a site southwest of the 200-East Area that is leased to the State of Washington. The facility is not a DOE facility and is not considered part of DOE's Hanford operations (DOE 1996b:E-17).

#### **3.4.11.5 Mixed Low-Level Radioactive Waste**

Miscellaneous dilute aqueous low-level radioactive and liquid mixed low-level radioactive wastes are temporarily stored in the Liquid Effluent Retention Facility until treated in the Liquid Effluent Treatment Facility. The Liquid Effluent Retention Facility consists of three RCRA-compliant surface impoundments for

storing process condensate from the 242-A Evaporator. This facility provides equalization of the flow and pH to the Liquid Effluent Treatment Facility. The Liquid Effluent Treatment Facility provides ultraviolet light/peroxide destruction of organic compounds, reverse osmosis to remove dissolved solids, and ion exchange to remove the last traces of contaminants. Discharge of the treated effluent is via a dedicated pipeline to an underground drain field. The effluent treatment process produces a mixed low-level radioactive waste sludge that is concentrated, dried, packaged in 208-liter (55-gallon) drums, and transferred to the Central Waste Complex. This secondary waste is stored prior to treatment, if necessary, and disposed in the Mixed Waste Trench (Dirkes and Hanf 1996:10, 45, 46).

The Waste Receiving and Processing Facility, near the Central Waste Complex in the 200 West Area, provides analyses, characterization, and preparation of drums and boxes for disposal of Hanford's mixed waste. The Waste Receiving and Processing Facility is designed to process 6,800 drums of waste annually and to prepare retrieved and stored transuranic waste for disposal (Dirkes and Hanf 1996:40).

The Radioactive Mixed Waste Disposal Facilities are in the Hanford Low-level Radioactive Waste Burial Ground and are designated as 218-W-5, Trench 31, and Trench 34. The facilities consist of rectangular trenches with approximate dimensions of 76 by 30 meters (250 by 100 feet). These facilities are RCRA compliant, with double liners and leachate collection and removal systems (Dirkes and Hanf 1996:40).

#### **3.4.11.6 Hazardous Waste**

There are no treatment facilities for hazardous waste at Hanford; therefore, the wastes are accumulated in satellite storage areas for less than 90 days, or at interim RCRA-permitted facilities, such as the 305-B Waste Storage Facility. The common practice for newly generated hazardous waste is to ship it off site by truck using DOT-approved transporters for treatment, recycling, recovery, and disposal at RCRA-permitted commercial facilities (DOE 1999e:3-11, 12).

#### **3.4.11.7 Nonhazardous Waste**

Sanitary wastewater is discharged to onsite treatment facilities such as septic tanks, subsurface soil adsorption systems, and wastewater treatment plants. These facilities treat an average of 600,000 liters (158,000 gallons) per day of sewage (DOE 1996b:E-19).

The 200 Area TEDF industrial sewer collects the treated wastewater streams from various plants in the 200 Areas and disposes of the clean effluent at two 2-hectare (5-acre) ponds permitted by the State of Washington (DOE 1996b:E-19). The design capacity of the facility is approximately 8,700 liters (2,300 gallons) per minute, although the discharge permit presently limits the average monthly flow to about 2,400 liters (640 gallons) per minute (Dirkes and Hanf 1996:46).

Nonhazardous solid wastes include construction debris, office trash, cafeteria wastes, furniture and appliances, nonradioactive friable asbestos, powerhouse ash, and nonradioactive/nonhazardous demolition debris. Until 1997, nonhazardous solid wastes were disposed of in the 600 Area central landfill. Under an agreement between DOE and the city of Richland, most of the site's nonregulated and nonradioactive solid wastes are now sent to the Richland Sanitary Landfill for disposal (DOE 1996b:3-65, E-19). The Richland Sanitary Landfill is at the southern edge of the Hanford Site boundary. Nonradioactive friable asbestos and medical waste are shipped off site for disposal to a commercial facility (DOE 1999e:3-12).

#### 3.4.11.8 Waste Minimization

The Hanford Site Pollution Prevention Program is a comprehensive and continual effort to systematically reduce the quantity and toxicity of hazardous, radioactive, mixed, and sanitary wastes; conserve resources and energy; reduce hazardous substance use; and prevent or minimize pollutant releases to all environmental media from all operations and site cleanup activities. In accordance with sound environmental management, preventing pollution through source reduction is the first priority in the Hanford Site Pollution Prevention Program, and the second priority is environmentally safe recycling. Implementation of pollution prevention projects reduced the total amount of waste generated at Hanford in 1998 by approximately 17,500 cubic meters (23,000 cubic yards). Examples of pollution prevention projects completed in 1998 at Hanford include: the reduction of cleanup and stabilization of mixed low-level radioactive waste by approximately 170 cubic meters (220 cubic yards) by decontaminating numerous items (including process tanks, machinery, floors, and associated equipment and piping) to low-level radioactive waste status, avoiding a mixed low-level radioactive wastestream and associated disposal costs; the reduction of hazardous waste by 22 metric tons (24 tons) by removing CFC-12 refrigerant from four of eight chillers and selling it to a vendor for reuse; and the reduction of cleanup and stabilization of mixed low-level radioactive waste by approximately 11 cubic meters (14 cubic yards) by recycling scrap metal from an underground tank system for use as radiation shielding blocks (DOE 1999f:64).

DOE has developed a draft *Waste Minimization and Management Plan for FFTF* to incorporate pollution prevention and waste minimization practices in its consideration of the future of FFTF (DOE 2000c). If a decision were made to restart FFTF, this plan would be used to ensure that optimum opportunities are provided for characterizing potential waste streams, identifying source reduction and recycling strategies, evaluating disposition options, developing sustainable designs, and implementing effective management strategies. This plan identifies DOE's preferred options for management, treatment, and/or disposition of all waste streams related to the restart and operation of FFTF. These preferred options primarily use commercial waste handling and disposal facilities.

#### 3.4.11.9 Waste Management PEIS Records of Decision

The *Waste Management PEIS* Records of Decision affecting Hanford are shown in **Table 3–37** for the waste types analyzed in this NI PEIS. Decisions on the various waste types were announced in a series of Records of Decision that have been issued on the *Waste Management PEIS*. The transuranic waste Record of Decision was issued on January 20, 1998 (63 FR 3629); the hazardous waste Record of Decision was issued on August 5, 1998 (63 FR 41810); the high-level radioactive waste Record of Decision was issued on August 12, 1999 (64 FR 46661); and the low-level radioactive waste Record of Decision was issued on February 18, 2000 (65 FR 10061). The transuranic waste Record of Decision states that DOE will develop and operate mobile and fixed facilities to characterize and prepare transuranic waste for disposal at WIPP.

Each DOE site that has or will generate transuranic waste will, as needed, prepare and store its transuranic waste on site. The hazardous waste Record of Decision states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own nonwastewater hazardous waste on site in existing facilities where this is economically favorable. The high-level radioactive waste Record of Decision states that immobilized high-level radioactive waste will be stored at the site of generation until transfer to a geologic repository. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision states that for the management of low-level radioactive waste, minimal treatment will be performed at all sites, and disposal will continue, to the extent practicable, on site at INEEL, LANL, ORR, and SRS. In addition,

**Table 3–37 Waste Management PEIS Records of Decision Affecting Hanford**

<b>Waste Type</b>	<b>Preferred Action</b>
High-level radioactive	DOE has decided that Hanford should store its high-level radioactive waste on site until transfer to a geologic repository <sup>a</sup>
Transuranic and mixed transuranic	DOE has decided that Hanford should prepare and store its transuranic waste on site pending disposal at WIPP or another suitable geologic repository. <sup>b</sup>
Low-level radioactive	DOE has decided to treat Hanford’s low-level radioactive waste on site. Hanford has been selected as one of the regional disposal sites for low-level radioactive waste. <sup>c</sup>
Mixed low-level radioactive	DOE has decided to regionalize treatment at Hanford. This includes the onsite treatment of Hanford’s wastes and could include treatment of some mixed low-level radioactive waste generated at other sites. Hanford has been selected as one of the regional disposal sites for mixed low-level radioactive waste. <sup>c</sup>
Hazardous	DOE has decided to continue to use commercial facilities for treatment of Hanford nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste. <sup>d</sup>

a. From the Record of Decision for high-level radioactive waste (65 FR 46661).

b. From the Record of Decision for transuranic waste (63 FR 3629).

c. From the Record of Decision for low-level radioactive and mixed low-level radioactive waste (65 FR 10061).

d. From the Record of Decision for hazardous waste (63 FR 41810).

**Source:** 63 FR 3629; 63 FR 44810; 64 FR 46661; 65 FR 10061.

Hanford and the Nevada Test Site will be available to all DOE sites for low-level radioactive waste disposal. Mixed low-level radioactive waste will be treated at Hanford, INEEL, ORR, and SRS, and disposed of at Hanford and the Nevada Test Site. More detailed information concerning DOE’s alternatives for the future configuration of waste management facilities at Hanford is presented in the *Waste Management PEIS* and the transuranic waste, hazardous waste, and low-level radioactive and mixed low-level radioactive waste Records of Decision.

### 3.4.12 Spent Nuclear Fuel

When nuclear assemblies can no longer be used in the nuclear reactor, they are designated as “spent nuclear fuel,” which is removed from the reactor and stored in the spent fuel storage pool, vessel, or basin. The Nuclear Waste Policy Act of 1982, as amended, assigned the Secretary of Energy the responsibility for developing of a repository for the disposal of high-level radioactive waste and spent nuclear fuel. When such a repository is available, spent nuclear fuel would be transferred for disposal from nuclear reactor site to the repository. Until a repository is available, spent nuclear fuel is stored in the reactor vessel, or in another acceptable method, such as in a dry cask storage system.

The current inventory of spent nuclear fuel at FFTF is approximately 11 metric tons of heavy metal, predominantly mixed plutonium-uranium oxide encapsulated in stainless steel. About 3 percent, (i.e., 0.3 metric tons of heavy metal) is of sodium-bonded spent nuclear fuel. In addition, there is 0.02 metric tons of heavy metal of training, research, isotopes General Atomics (TRIGA) spent nuclear fuel. This constitutes less than 1 percent of the cumulative spent nuclear fuel (about 2,133 metric tons of heavy metal), including defense and nondefense fuel at Hanford. DOE is managing this spent fuel in accordance with the Environmental Assessment, *Management of Hanford Site Non-Defense Production Reactor Spent Nuclear Fuel* and the associated Finding of No Significant Impact (DOE 1997f, 1997g).